NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

Computer Science Engineering

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Course Curriculum

FOR B.TECH-CSE&IT COURSE
(Effective from Academic session 2021-2022)

Introduction-B.Tech in Computer Science Engineering, which is commonly known as Computer Science Engineering, is undoubtedly one of the most sought after specialisations of engineering. B.Tech in Computer Science Engineering (CSE) is an academic programme of the duration of four years which integrates the field of Computer Science and Computer Engineering. The programme primarily lays emphasis on the basics of computer programming and networking while also comprising a plethora of topics.

Program Educational Objectives (PEOs)

The Department of Computer Science & Engineering& Information Technology has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of CS/IT Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Programme specific outcome (PSO)

- PSO1: Theoretical Computer Science: Students at the time of graduation will be able to apply fundamental knowledge of theoretical computer science and critically analyze problems to provide computer based solutions for engineering applications.
- PSO2: Hardware and software systems: Students at the time of graduation will be able to design cost effective hardware/software systems and components for engineering/social applications using the knowledge of hardware and/or software architecture, programming and development.
- PSO3: Technology: Students at the time of graduation will be able to apply appropriate technology to find solutions for complex problems.
- PSO4: Research Capability: Students at the time of graduation will be able to apply domain knowledge and expertise for enhancing research capability to transform innovative ideas into reality

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B.Tech:

- Every semester shall offer a minimum of **12 credits** and a maximum of 24 **credits**.
- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. tech Degree Course could vary from a **minimum of 158** credits to a **maximum of 178** credits.
- All courses of study put together would engage the students for a **minimum of 26 periods** or hours of study a week and a **maximum of 30 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
    (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to thediscipline or subject of study or which provides an extended scope
    (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain ornurtures the candidate‘s proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	24
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	29
4	Professional core courses	49
5	Professional Elective courses relevant to chosen specialization/branch	18
6	Open subjects – Electives from other technical and /or emerging Subjects	12
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory Courses	0
		*159

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical(Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	15	5.5	20.5
2nd	12	5.5	17.5
3rd	15	8	23
4th	18	6	24
5th	17	7	24
6th	15	7	22
7th	12	3	15
8th	6	6	12
Total	110	48	158

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
PCC : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

Bachelor of Technology-CSE

First Semester

S.No	Course Code	Subject	Period			Evaluation Scheme						
						Internal Assessment			External Assessment	Total	Total Credits
			L	T	P	CA	TA	Total			
1	BSC 103	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC102	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC 101	English	2	0	0	20	20	40	60	100	2
4	ESC103	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5	ESC102	Engineering Graphics & Design	1	0	0	20	20	40	60	100	1
		Induction Program	-	-	-	-	-	-	-		0
PRACTICALS											
1	BSC 102P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC103P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	ESC102P	Engineering graphics & Design Lab	0	0	4	-	-	40	60	100	2
4	HSMC101P	English Lab	0	0	2	-	-	40	60	100	1
Total											**20.5**

SECOND SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					
						Internal Assessment			External Assessment	Total	Total Credits
			L	T	P	CA	TA	Total			
1	BSC101	Physics	3	1	0	20	20	40	60	100	4
2	BSC 104	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC104	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	Environmental Studies	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC101P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1

THIRD SEMESTER

COURSE		Contact Hours/Week			Credit	Evaluation Scheme				
Code	Course Title	L	T	P		CA	TA	Int. Total	Ext.	Total
BSC301	Discrete Mathematics	3	0	0	2	20	20	40	60	100
ESC301	Analog Electronic Circuits	3	0	0	3	20	20	40	60	100
ESC302	Digital Electronics	3	0	0	3	20	20	40	60	100
PCC-CS301	Data Structure & Algorithms	3	0	0	3	20	20	40	60	100
PCC-CS302	IT Workshop	1	0	0	1	20	20	40	60	100
HSMC301	Humanities –I (Human psychology)	3	0	0	3	20	20	40	60	100
PRACTICALS										
ESC301P	Analog Electronic Circuits Lab	0	0	4	2	20	20	40	60	100
ESC302P	Digital Electronics Lab	0	0	4	2	20	20	40	60	100
PCC-CS301P	Data Structure & Algorithms Lab	0	0	4	2	20	20	40	60	100
PCC-CS302 P	IT Workshop (MATLAB) Lab	0	0	4	2	20	20	40	60	100
Total		**16**	**0**	**16**	**23**					
FOURTH SEMESTER										
PCC-CS401	Computer Based Numerical & Statistical Techniques	3	0	0	3	20	20	40	60	100
PCC-CS402	Computer Organization & Architecture	3	0	0	3	20	20	40	60	100
PCC-CS403	Operating Systems	3	0	0	3	20	20	40	60	100
PCC-CS404	Design &Analysis of Algorithms	3	0	0	3	20	20	40	60	100
HSMC-401	Humanities –II (Human Values)	3	0	0	3	20	20	40	60	100
BSC-401	Biology	2	1	0	3	20	20	40	60	100
PRACTICALS										
PCC-CS402P	Computer Organization & Architecture Lab	0	0	4	2	20	20	40	60	100
PCC-CS403P	Operating Systems Lab	0	0	4	2	20	20	40	60	100
PCC-CS404P	Design &Analysis of Algorithms Lab	0	0	4	2	20	20	40	60	100
Total		**17**	**1**	**12**	**24**					

FIFTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
ESC-501	Signal &Systems	3	0	0	3	20	20	40	60	100
PCC-CS501	Database Management Systems	3	0	0	3	20	20	40	60	100
PCC-CS502	Formal Language & Automata Theory	3	0	0	3	20	20	40	60	100
PCC-CS503	Object Oriented Programming	2	0	0	2	20	20	40	60	100
	Elective I	3	0	0	3	20	20	40	60	100
HSMC501	Management I(OB/F&A*)	3	0	0	3	20	20	40	60	100
PRACTICALS										
PCC-CS501P	Database Management Systems Lab	0	0	4	2	20	20	40	60	100
PCC-CS503P	Object Oriented Programming Lab	0	0	4	2	20	20	40	60	100
PROJ-CS50	Industrial Seminar**	0	0	6	3	20	20	40	60	100
Total		**17**	**0**	**14**	**24**					
SIXTH SEMESTER										
PCC-CS601	Compiler Design	3	0	0	3	20	20	40	60	100
PCC-CS602	Computer Networks	3	0	0	3	20	20	40	60	100
	Elective II	3	0	0	3	20	20	40	60	100
	Elective III	3	0	0	3	20	20	40	60	100
OEC001	Soft Skills & interpersonal Communication	3	0	0	3	20	20	40	60	100
MC601	Constitution of India/Essence of Indian traditional knowledge	0	0	0	0	20	20	40	60	100
PRACTICALS										
PCC-CS601P	Compiler Design	0	0	4	2	20	20	40	60	100
PCC-CS602P	Computer Networks	0	0	4	2	20	20	40	60	100
PROJ-CS60	Project –I**	0	0	6	3	20	20	40	60	100
	Total	**15**	**0**	**14**	**22**					

***OB/F&A- Organizational Behavior/ Finance & Accounting**

****The marks will be awarded on the basis of 06 weeks industrial training conducted after 4th semester**

SEVENTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
	Elective IV	3	0	0	3	20	20	40	60	100
	Elective V	3	0	0	3	20	20	40	60	100
	Elective VI	3	0	0	3	20	20	40	60	100
OEC002	HRD & OB *	3	0	0	3	20	20	40	60	100
PRACTICALS										
PROJ-CS70	Project-II**	0	0	6	3	20	20	40	60	100
Total		**12**	**0**	**6**	**15**					

EIGHTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
OEC003	Cyber Law & Ethics	3	0	0	3	20	20	40	60	100
OEC004	History of Science & engineering/Introduction to Philosophical Thoughts/Metro Systems and Engineering	3	0	0	3	20	20	40	60	100
PRACTICALS										
PROJ-CS80	Project III**	0	0	12	6	100	100	200	300	500
Total		**6**	**0**	**12**	**12**					

*** HRD & OB- Human Resource Development & Organizational Behavior**

**** Project Synopsis Seminar**

****The marks will be awarded on the basis of Industrial Project Training in 8th semester**

LIST OF ELECTIVES

Thread 1: Theory & Algorithms		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-T 501	Graph Theory
Elective II	PEC-CS-T 601	Advanced Algorithms
Elective III	PEC-CS-T 602	Parallel & Distributed Algorithms
Elective IV	PEC-CS-T 701	Computational Complexity
Elective V	PEC-CS-T 702	Computational Complexity
Elective VI	PEC-CS-T 703	Queuing Theory & Modeling
Additional Subject (can replace with any elective from the same thread): Theory Of Computation		

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Thread 2: Systems		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-S 501	Advanced Computer Architecture
Elective II	PEC-CS-S 601	Software Engineering
Elective III	PEC-CS-S 602	Distributed Systems
Elective IV	PEC-CS-S 701	Embedded Systems
Elective V	PEC-CS-S 702	Advanced Operating Systems
Elective VI	PEC-CS-S 703	Low Power Circuit & Systems
Additional Subject (can replace with any elective from the same thread): Fault Tolerant Computing		

Thread 3: Data Science & Machine Intelligence		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-D 501	Artificial Intelligence
Elective II	PEC-CS-D 601	Machine Learning
Elective III	PEC-CS-D 602	**Data Mining
Elective IV	PEC-CS-D 701	Soft Computing
Elective V	PEC-CS-D 702	Speech and Natural Language Processing
Elective VI	PEC-CS-D 703	**Data Analytics

Thread 4: Applications		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-A 501	Image Processing
Elective II	PEC-CS-A 601	Digital Signal Processing
Elective III	PEC-CS-A 602	**Cloud Computing
Elective IV	PEC-CS-A 701	Human Computer Interaction
Elective V	PEC-CS-A 702	Electronic Design Automation
Elective VI	PEC-CS-A 703	Computer Graphics

Semester	**Credits**		
	Theory	Practical	Total
1^{st}	15	5.5	20.5
2^{nd}	12	5.5	17.5
3^{rd}	15	8	23
4^{th}	18	6	24
5^{th}	17	7	24
6^{th}	15	7	22
7^{th}	12	3	15
8^{th}	6	6	12
Total	110	48	158

DETAILED 4-YEAR CURRICULUMCONTENTS

Undergraduate Degree in Engineering &Technology

BRANCH/COURSE: COMPUTER SCIENCE AND ENGINEERING

AND

INFORMATION TECHNOLOGY

Course Code: BSC101

Course Name: Mathematics-I

Course Credit Hour: 4hr

Total Contact Hour: 40hrs

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems
- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:

https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: BSC102 **Course Name:** Chemistry-I

Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

➢ The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.

  The properties of a compound are not only determined by the functional groups that it contains, but also by the spatial arrangements of the atoms in the molecule. Stereochemistry is the branch of chemistry that is concerned with the three-dimensional structures of molecules.

  After studying this unit I should be able to diastereomer
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, “ University chemistry”, Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, “Chemistry: Principles and Applications”, McGraw- -ill International.
- C. N. Banwell, “Fundamentals of Molecular Spectroscopy”, McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, “Engineering Chemistry” (NPTEL).
- K. P. C. Volhardt and N. E. Schore, “ Organic Chemistry: Structure and Function” Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam)	-	20%
Assignment-4	-	05%
Assignment-5/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC101 **Course Name:** English

Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication (4 lectures)(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.
- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: ECS101 **Course Name:** Programming for Problem Solving

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays

Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 6: Recursion

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure

Structures, Defining structures and Array of Structures.

Unit 8: Pointers

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

1. Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
2. E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
3. Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving

Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

   R=1 c=1 sum=2

   R=1 c=2 sum=3

   R=2 c=1 sum =3

   R=2 c=2 sum=4
6. Write a program to print the following pattern
7. Write a program to print the square and cube of any given number.
8.

```
*****     *         1
*****     **        12
*****     ***       123
*****     ****      1234
          *****     12345
```

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
    - Find the length of the string.
    - Concatenate two strings
    - Compare two given strings
    - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().

6. Write a program to add two numbers using pointers.
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab

Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr’s Method.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodium hydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

Course Code: BSC102 **Course Name:** Physics

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)

Introduction to Quantum mechanics

Wave nature of particles

Time independent and time dependent Schrodinger equation for wave function

Born interpretation

Probability current

Expectation values

Free particle wavefunction and wave packets

Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)

Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator

Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)

Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)

Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:
https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: BSC103 **Course Name:** Mathematics II

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

Unit 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for *x* and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.

- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.
- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: ESC102 **Course Name:** Workshop/Manufacturing Practices

Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1 Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel. Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual. Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint. **Gas & Spot Welding** To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

Module V Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: ESC104 **Course Name:** Basic Electrical Engineering

Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

<u>Unit 1</u>: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

<u>Unit 2:</u> AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

<u>Unit 3:</u> Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

<u>Unit 4:</u> Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

<u>Unit 5</u>: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

<u>Unit 6</u>: Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, " Basic Electrical Engineering", Tata McGraw Hill.
- D. C. Kulshreshtha, " Basic Electrical Engineering", McGraw Hill.

Reference books:

- L. S. Bobrow, " Fundamentals of Electrical Engineering", Oxford University Press.
- E. Hughes, "Electrical and Electronics Technology", Pearson.
- V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: AECCI **Course Name:** Environmental Science

Course Credit Hour: 2hr **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem -Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem

Physical (energy flow), Biological (food chains, food web, ecological succession) and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis

- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity

- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

Unit 5: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

Unit 6: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 200

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):

The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.

- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 □
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 □
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 □
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:

https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Lab Code: BSC101P

Lab Name: Physics Lab

Course Credit Hour: 1.5hr

Total Contact Hour: 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC102P **Lab Name:** Workshop/Manufacturing Practice

Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: ESC104P **Lab Name:** Electrical Engineering Lab

Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

Course Code: BSC301 **Course Name:** Discrete Mathematics

Course Credit Hour: 2hr **Total Contact Hour:** 40hrs

Course Objective:

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to use mathematically correct terminology and notation, construct correct direct and indirect proofs, use division into cases in a proof, use counter examples and apply logical reasoning to solve a variety of problems.

Course Description:

This course provides wide knowledge ofDiscrete Mathematics. Topics included: Basic of Sets, Relation and function, Principal of mathematical induction, counting technique, propositional logics, algebraic structure and graphs and tree with their applications.

Course Contents:

Unit 1: Sets, Relation and Function (8 hours)

Operations and Laws of Sets, Cartesian Products, BinaryRelation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum andProduct of Functions, Bijective functions, Inverse and Composite Function, Size of a Set,Finite and infinite Sets, Countable anduncountable Sets, Cantor's diagonal argument andThe Power Set theorem, Schroeder-Bernstein theorem.

Unit-2: Principles of Mathematical Induction& Basic Counting Technique (8 hours)

The Well-Ordering Principle, Recursivedefinition, The Division algorithm: Prime Numbers, The Greatest Common Divisor:Euclidean Algorithm, The Fundamental Theorem of Arithmetic.Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

Unit 3: Propositional Logic (8 hours)

Syntax, Semantics, Validity and Satisfiability, Basic Connectives andTruth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules ofInference, The use of uantifiers. **Proof Techniques:** Some Terminology, Proof Methodsand Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof ofNecessity and Sufficiency.

Unit 4: Algebraic Structures and Morphism (10 hours)

Algebraic Structures with one Binary Operation,Semi Groups, Monoids, Groups, CongruenceRelation and Quotient Structures,Free and Cyclic Monoids and Groups, Permutation Groups,Substructures, NormalSubgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domainand Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra,Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Unit 5: Graphs and Trees (8 hours)

Graphs and their properties, Degree, Connectivity, Path, Cycle,Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring mapsand Planar Graphs,Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph,definition properties and Example, rooted trees, trees and sorting, weighted trees and prefixcodes, Bi-connected component and Articulation Points, Shortest distances.

Course Learning Outcomes (CLOs):

CLO-1: For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.

CLO-2: For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.

CLO-3: For a given a mathematical problem, classify its algebraic structure.

CLO-4: Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.

CLO-5: Develop the given problem as graph networks and solve with techniques of graph theory.

Text books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill

2. Susanna S. Epp, Discrete Mathematics with Applications,Wadsworth Publishing Co. Inc.

3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, Tata McGraw – Hill.

Reference books:

1.Discrete Mathematics, Tata McGraw – Hill
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill.
3. Norman L. Biggs, Discrete Mathematics, Oxford University Press.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: ESC301

Course Name: Analog Electronic Circuits

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

- To understand Diodes and their application.
- To analyze BJT and understand the various application.
- To understand characteristics of op amp and MOSFET.
- To understand concepts of non linear application of OP amp.

Course Description:

This course emphasizes on the fundamental of Analog electronics. The course includes basic devices structure, application and working. This course gives an understanding of analog circuits.

Course Contents:

Unit 1: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit 2: BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common- collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit 3: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit 4: Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit 5: Linear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

Unit 6: Nonlinear applications of op-amp

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- At the end of this course, students will demonstrate the ability to
- Understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Text books:

- S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
- J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifiertheory and applications”, McGraw Hill U. S., 1992.
- J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988., “Digital Logic and Computer Design”, PHI Publications, 2002

Reference books

- P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
- P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated

Circuits”, John Wiley & Sons, 2001.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102112/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: ESC 302

Course Name: Digital Electronics

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems.

Course Description:

This course emphasizes on the fundamental of digital electronics. The student is first taught about the number system and logic gates before introducing them to digital IC technology. Then they are exposed to both combinational logic network and combinational MSI logic. In concurrence with this, the fundamental of sequential logic, flip-flop, counter and shift register will be taught. A/D & D/A convertors are summarized. Finally, the memory devices are introduced.

Course Contents:

Module 1:Fundamentals of Digital Systems and logicfamilies (8 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-ORoperations, Boolean algebra, examples ofICgates, number systems-binary, signed binary,octal hexadecimal number, binaryarithmetic,one's and two's complements arithmetic,codes, error detecting and correctingcodes,characteristics of digital lCs, digital logicfamilies, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational DigitalCircuits (8 Hours)

Standard representation for logic functions, K-map representation, simplificationoflogicfunctions using K-map, minimization of logical functions. Don't care conditions,Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry lookahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digitalcomparator,paritychecker/generator, code converters, priority encoders, decoders/driversfor display devices,Q-M method of functionrealization.

Module 3: Sequential circuits and systems (8 Hours)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T andDtypesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel converter, parallel to serial converter, ring counter, sequencegenerator,ripple(Asynchronous) counters, synchronous counters, counters design using flipflops,specialcounter IC's, asynchronous sequential counters, applications ofcounters.

Module 4: A/D and D/A Converters (8 Hours)

Digital to analog converters: weighted resistor/converter, R-2R LadderD/Aconverter,specifications for D/A converters, examples of D/A converter lCs, sampleand hold circuit,analog to digital converters: quantization and encoding, parallelcomparator A/Dconverter,successive approximation A/D converter, counting A/Dconverter, dual slope

A/Dconverter,A/Dconverterusingvoltagetofrequencyandvoltagetotimeconversion,specificationsofA/Dconverters, example ofA/D converterICs

Module 5: Semiconductor memories and Programmable logic devices. (8 Hours)

Memory organization and operation, expanding memory size, classificationandcharacteristicsof memories, sequential memory, read only memory (ROM), read andwrite memory(RAM), content addressable memory (CAM), charge de coupled devicememory (CCD), commonly used memory chips, ROM as a PLD, Programmable logicarray, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Text books:

- Moris Mano, “Digital Logic and Computer Design”, PHI Publications, 2002
- R. P. Jain, “Modern Digital Electronics”, TMH, 3rd Edition, 2003.

Reference books:

- Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
- R.L. Tokheim, “Digital Electronics, Principles and Applications”, Tata McGraw Hill, 1999.
- W. Gothman, “Digital electronics”, PHI.
- S. Salivahanan& S. Arivyhgan. “Digital circuits and design”, Vikas Publication, 2001
- Malvino Leach, "Digital Principles and Application", TMH, 1999.
- V. Rajaraman : Computer Fundamentals (PHI)

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS301 **Course Name:** Data Structure & Algorithms

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures.

Course Description:

- Study of advanced programming topics focused on logical structures of data as well as the design, implementation and analysis of algorithms operating on these structures.
- Topics include linked lists, stacks, trees, queues, graphs and analysis of efficiency. Also covers searching, sorting and hashing techniques.

Course Contents:

Module 1: Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module 2: Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3: Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4: Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Course learning outcomes:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.

5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition byMarkAllen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer" , 2nd Impression by R. G. Dromey, Pearson Education.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS302

Course Name: IT Workshop (MATLAB)

Course Credit Hour: 1hr

Total Contact Hour: 15hr

Course Objective

- To Impart the Knowledge to the students with MATLAB software.
- To provide a working introduction to the MATLAB technical computing environment.
- To introduce students the use of a high-level programming language using MATLAB.

Course Description:

- The course covers the basic concepts and techniques of MATLAB computing environment from both theoretical and practical perspective. The material includes Introduction to Matlab, Historical Background, Applications and scope of MATLAB, Commands, Data types, Operators, Data and Data Flow, Matlab Advanced Plotting and Mathematical Modeling.

Course Contents:

Unit-1

Introduction to Matlab, Historical Background, Applications, Scope of MATLAB, Importance of MATLAB for Engineers, Features, MATLAB Windows (Editor, Work Space, Command History, Command Window). Operations with Variables, Naming and Checking Existence, Clearing Operations, Commands, Data types, Operators.

Unit-II

Data And Data Flow In Matlab Vectors, Matrix Operations & Operators, Reshaping Matrices, Arrays, Colon Notations, Numbers, Strings, Functions, File Input-Output, Importing and Exporting of data.

Unit-III

Matlab Programming Conditional Statements, Loops, Writing Script Files, Error Correction, Saving Files, Worked out Examples.

Unit-IV

Matlab Advanced Plotting, Graphics, Creating Plot & Editing Plot, GUI (Graphical User Interface). Matlab-Algebra, Calculus, Differential, Integration, Polynomials, solving a system of linear equations.

Unit-V

Simulink Introduction, Importance, Model Based Design, Tools, Mathematical Modeling, Converting Mathematical Model into Simulink Model, Running Simulink Models, Importing Exporting Data, Solver Configuration, Masking Block/Model.

Course Learning Outcomes (CLOs): On completion of the course students will be able to

- **CLO-1**: Understand the introduction of MATLAB environment.
- **CLO-2**: Understand and apply the operation of MATLAB in data flow operations.
- **CLO-3**: Write the various MATLAB programming scripts.
- **CLO-4**: Plot graphs of linear and polynomial equations using various MATLAB functions.
- **CLO-5:** Perform mathematical modeling, importing and exporting of data using Simulink.

Text books:

- Rudra Pratap , Getting Started With Matlab: A Quick Introduction For Scientists And Engineers , OXFORD University Press.
- Y. Kirani Singh, B.B. Chaudhuri , Matlab Programming ,PHI Publication

Reference Books:

- Y. Yang ,Wenwu Cao, Tae-Sang Chung, John Morris ,Applied Numerical Methods Using MATLAB , PHI Publication.

Online links for study & reference materials:

https://nptel.ac.in/courses/103/106/103106118/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 301 **Course Name:** Human Psychology

Course Credit Hour:3Hr **Total Contact Hour:**20hr

Course Objective:

- The student will acquire knowledge of human psychology including workplace environment, Motivation and perception.

Course Description:

- This course introduces the fundamental of human psychology includes important insights about motivation, leadership, perception and work environment.

Course Contents:

Unit 1:Introduction to Psychology(5 lectures)

Definitions & Scope. Types and branches of psychology Major influence on Psychology- Scientific Management and Human relations -Hawthorne Experiments. Taylor Principles, Implications of Psychology on Modern Industries and behavior

Unit 2: Individual at workplace (5lectures)

Attention and Perception, Individual at Workplace-Attitude, Motivation and Job satisfaction. Stress management. Leadership and Group dynamics.

Unit 3:Work Environment & Engineering Psychology-(5 lectures)

Engineering psychology: fatigue, Monotony, Boredom. Accidentsand Safety. Emotional and social development, Cognitive development. Consumer behavior analysis.

Unit 4:Job Analysis (5 lectures)

Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests. Performance Management: Training & Development, Appraisals.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human psychology.

CLO-2: Inculcate leadership and motivational skills.

CLO-3: To understand consumer behavior and emotional development.

CLO-4:To understand about job recruitment process and interviews methods.

Text books:

(i) Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
(ii) Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.

Reference books:

(i) Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.
(ii) Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

ESC301P	**Analog Electronic Circuits Lab**	**0L:0T:4P**	**2 credits**

List of Experiments

1. To study the characteristics of P-N junction diode.
2. To study a half wave and full wave rectifier circuit.
3. To study the V-I characteristics of zener diode
4. To study the zener diode as constant voltage regulator.
5. Determine the input output characteristics of BJT in CB, and CE configuration.
6. Determine the input output characteristics of FET in CS & CD configuration.
7. To study of BJT as single stage amplifier and determination of Ai, Av, Ri, Ro.
8. To study the opamp as an inverting & non-inverting amplifier.
9. To use the opamp as an adder, subtractor, integrator & differentiator.
10. To design a ramp and a square wave generator.
11. To study of (i) Wein bridge oscillator (ii) Phase shift oscillator.
12. To design low pass, high pass and band pass filters using op-amp and plot their frequency response.

ESC302P	Digital Electronics Lab	0L:0T:4P	2 credits

LIST OF EXPERIMENTS

1. Verification of NAND, NOR, Ex-OR,AND& OR Gates.
2. Implementation of half Adder & Full Adder
3. Implementation of half Subtractor & Full Subtractor.
4. Implementation of Demultiplexer / Decoder operation using IC-74138.
5. Implementation of Seven segment display.
6. Implementation of Binary to gray converter.
7. Implementation of Arithmetic algorithms.
8. Implementation of various flip-flops.
9. Implementation of Counters.
10. Implementation of shift register.
11. Verification of Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.

PCC-CS301P	Data Structure & Algorithms	0L:0T: 4P	2 credits

LIST OF EXPERIMENTS

Write programs in C for following:

1. Write a program to demonstrating Linear Search
2. Write a program to demonstrating Binary Search
3. Write a program to demonstrating Bubble Sort
4. Write a program to demonstrating Selection Sort
5. Write a program to demonstrating Insertion Sort
6. Write a program to demonstrating Merge Sort
7. Write a program to demonstrating Quick Sort
8. Write a program to demonstrating all operations on String without using standard library file
9. Write a program to demonstrating Single Linked List
10. Write a program to demonstrating Stack operations using array/Linked List
11. Write a program to demonstrating Queue operations using Linked list/Array
12. Program for demonstrating Binary Search Tree Using Linked List/Array

PCC-CS302P	**IT Workshop Lab**	**0L:0T: 4P**	**2 credit**

LIST OF EXPERIMENTS

1. Write a Program in M File to find the roots of a Quadratic Equation.
2. Consider the Matrix A=

[1 2 3 5 4 4 5 6 1 3 7 8 9 2 2]

Write a MATLAB Code to obtain the following matrix

[7 8 2 2 4 5 1 3 1 2 5 4]

3. W.A.P in MATLAB to solve the following linear equation:

$$3x^4 + x^3 + 6x^2 + x + 4 = 0$$

$$x^4 + 3x^3 + 2x^2 + 41 = 0$$

4. W.A.P to plot the following two functions for 30 Data Points from 0 to 2π by using Plot Command.
5. W.A.P to display the AND,OR & NOT Program
6. W.A.P. in MATLAB to convert Centigrade values to Fahrenheit values. The Values of the the temp in Centigrade will be taken as input from the user.
7. W.A.P to create a recursive function to find the factorial of a number.
8. W.A.P in MATLAB to show the use of the following operators
   (i) All operator (ii) any operator
9. Create a MATLAB Code to create the chessboard on a white background.
10. W.A.P in MATLAB to make a ribbon plot of the following function
    Z = 20 + Cos (0.5 * x) + 20 * Sin(0.5 * y)

Course Code: PCC-CS401 **Course Name:** Computer Based Numerical & Statistical Techniques

Course Credit Hour: 3hr **Total Contact Hour:**40hrs

Course Objective:

A good Engineer has to have an excellent background of Mathematics. Numerical and statistical techniques are one of the essential tools for learning Technology. This course is tofamiliarisethe students with statistical and numerical techniques needed in problem-solving and industrial applications.

Course Description:

This course provides an introduction to numbers and accuracy and wide knowledge of methods for solving transcendental equation, Interpolation, numerical integration and differentiation, solution of differential equation and statistical technique with their applications.

Course Contents:

Unit 1: (8 hours)

Introduction: Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphsonmethod, Methods of finding complex roots, Muller‟s method, Rate of convergence ofIterative methods, Polynomial Equations.

Unit 2: (10 hours)

Interpolation: Finite Differences , Difference tables Polynomial Interpolation:Newton's forward and backward formula Central Difference Formulae: Gauss forwardand backward formula, Stirling‟s, Bessel‟s, Everett‟s formula.Interpolation with unequal intervals: Langrange‟s Interpolation, Newton Divideddifference formula, Hermite‟s Interpolation

Unit 3: (12 hours)

Numerical Integration and Differentiation: Introduction, Numerical differentiationNumerical Integration: Trapezoidal rule, Simpson‟s 1/3 and 3/8 rule, Boole‟s rule,Waddle‟s rule.

Solution of differential Equations: Picard‟s Method, Euler‟s Method, Taylor‟sMethod, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoringand Stability of solution.

Unit 4: (10 hours)

Statistical Computation: Frequency chart, Curve fitting by method of least squares,fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubicsplines, Regression Analysis, Linear and Non-linear Regression, Multiple regression,Statistical Quality Control methods.

Course Learning Outcomes (CLOs):

CLO-1: Recognize the error in the number generated by the solution.

CO2. Compute solution of algebraic and transcendental equation by numerical methods.

CLO-3: Apply method of interpolation and extrapolation for prediction.

CLO-4:Evaluation of numerical differentiation and integration.

CLO-5: To find solution of differential equation.

CLO-6: Computation of statistical technique.

Text books:

1. Grewal B S, “Numerical methods in Engineering and Science”, Khanna Publishers, Delhi.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

Reference books:

(i) Numerical Method Principles, analysis and algorithms ,Srimamta Pal (Oxford Higher ed).
(ii) Rajaraman V, “Computer Oriented Numerical Methods”, PHI, 3rd edition.

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106033/

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS402 **Course Name:** Computer Organization & Architecture

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on microprogramming
- Concepts of advanced pipelining techniques.

Course Description:

- This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems.
- Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors.

Course Contents:

Module 1:Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTLinterpretation ofinstructions, addressing modes, instruction set. Case study – instruction sets of some commonCPUs.
Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating pointarithmetic.

Module 2:Introduction to x86 architecture.CPU control unit design: hardwired and microprogrammed design approaches, Case study – design of a simple hypotheticalCPU.Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics:Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process statetransitions, I/O device interfaces – SCII, USB

Module 3: Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.Parallel Processors:Introduction to parallel processors, Concurrent access to memory and cachecoherency.

Module 4: Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, writepolicies.

Course learning outcomes:

1. “Computer Organization and Design: The Hardware/Software Interface” , 5th Edition by David A. Patterson and John L. Hennessy,Elsevier.
2. “Computer Organization and EmbeddedSystems” , 6th Editionby CarlHamacher, McGraw Hill HigherEducation.

Suggested reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance" , 10th Edition by William Stallings, PearsonEducation.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, PearsonEducation.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS403 **Course Name:** Operating Systems

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and theircommunication
- To learn the mechanisms involved in memory management in contemporaryOS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

Module 1: Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS OperatingSystem.

Module 2: Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,
Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer/Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4: Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5: Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation–Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Pageallocation– Hardware support for paging, Protection and sharing, Disadvantages ofpaging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

Module 6:I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Course learning outcomes:

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia StudentEdition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC CS404

Course Name : Design & Analysis of Algorithm

Course Credit Hour: 3hr

Total Contact Hour : 42hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description :

Algorithms are the soul of computing. It can be roughly described as creating "recipes" (well defined sequences of computational steps) for getting "things" (computational problems specifying an input-output relation) "successfully" (correctly) "done" (in finite steps and time). This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, elements of computational geometry, NP completeness.

Course Contents :

Module 1:

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Module 2:

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Module 3:

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Module 4:

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Module 5:

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – PSPAC

Course Learning Outcomes (CLOs):

CLO-1: For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

CLO-2: Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

CLO-3: Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

CLO-4: Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.

CLO-5: Develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

CLO-6: For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

CLO-7: Explain the ways to analyze randomized algorithms (expected running time, probability of error).

CLO-8: Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

Text books :

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 4TH Edition, MITPress/McGraw-Hill, 9780262032933, 0262032937
2. E. Horowitz etal. , Sartaj Sahni, Fundamentals of Algorithms , Computer Science Press 9783540120353, 3540120351

Reference books :

1. Jon Kleinberg and ÉvaTardos, Algorithm Design, 1ST Edition, Pearson, 9788131703106, 813170310X
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 9780471427568, 047142756X

Online links for study & reference materials:

https://lecturenotes.in/subject/12/design-and-analysis-of-algorithm-daa/note

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 401 **Course Name:** Human Values

Course Credit Hour:3Hr **Total Contact Hour:** 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Description:

- This course introduces the fundamental ofhuman values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.

2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.

2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.

3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

4. Understanding the characteristics and activities of 'I' and harmony in 'I'.

5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

6. Programs to ensure Sanyam and Health.

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature

2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4.Holistic perception of harmony at all levels of existence.

Unit 5 : Implications of the above Holistic Understanding of Harmony on Professional Ethics

1.Natural acceptance of human values

2. Definitiveness of Ethical Human Conduct

3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human values

CLO-2: To understand the importance of self-exploration process

CLO-3: To understand harmony at individual levels

CLO-4: To understand harmony at nature level

CLO-5: Develop professional ethics

Textbooks:

(i) Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
(ii) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:

1.Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: BSC-401 **Course Name:** Biology
Course Credit: 3 **Total Contact Hour:** 33hr

Course Objective:

- ✓ To increase the understanding of living systems.
- ✓ To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
- ✓ To understand the Hierarchy of life forms at phenomenological level.
- ✓ To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"Mendel's laws, Concept of segregation and independent assortment.
- ✓ To learn the systems in relationship to the self and other organisms in the natural environment.
- ✓ To analyze biological processes at the reductionistic levelProteins- structure and function.
- ✓ To know and learn the fundamental principles of energy transactions.

Course Description:

This course explains the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal and populationlevels of the biological hierarchy.

Course Content:

Module 1. (2 hours)- Introduction
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics andChemistryBring out the fundamental differences between science and engineering by drawing a comparisonbetween eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as anindependent scientific discipline. Why we need to study biology? Discuss how biological observationsof 18th Century that lead to major discoveries. Examples from Brownian motion and the origin ofthermodynamics by referring to the original observation of Robert Brown and Julius Mayor. Theseexamples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification
Purpose: To convey that classification per se is not what biology is all about. The underlyingcriterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchyClassification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b)ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs,heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataaquaticor terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism cancome under different category based on classification. Model organisms for the study of biologycome from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M.musculus.

Module 3. (4 hours)-Genetics
Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Genemapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasisto be give not to the mechanics of cell division nor the phases but how genetic material passes fromparent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype togenes. Discuss about the single gene disorders in humans. Discuss the concept of complementationusing human genetics.

Module 4. (4 hours)-Biomolecules
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations areas diverse as one can imagineMolecules of life. In this context discuss monomeric units and polymeric structures. Discuss aboutsugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbonunits and lipids.

Module 5. (4 Hours). Enzymes
Purpose: To convey that without catalysis life would not have existed on earthEnzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions?Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzymekinetics and kinetic parameters. Why should we know these parameters to understand biology? RNAcatalysis.

Module 6. (4 hours)- Information Transfer
Purpose: The molecular basis of coding and decoding genetic information is universalMolecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefromsingle stranded to double helix to nucleosomes. Concept of genetic code. Universality anddegeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis
Purpose: How to analyses biological processes at the reductionistic levelProteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary andquaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism
Purpose: The fundamental principles of energy transactions are the same in physical and biologicalworld.Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonicand exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP asan energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis andKrebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding andenergy consuming reactions. Concept of Energy charge.

Module 9. (3 hours)- Microbiology
Concept of single celled organisms. Concept of species and strains. Identification and classificationof microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization andmedia compositions. Growth kinetics.

Course Learning Outcomes(CLOs):

At the end of this course students will learn:

- The major types of molecules that make up living organisms and how these molecules enable life functions.
- The structures found in cells and the functions of those sub-cellular structures.
- The processes by which cells replicate to produce genetically identical, or genetically variable, daughter cells.
- The roles carbohydrates play in biological systems
- The structure and function of proteins
- Nucleic acids and the role they play in DNA and RNA
- Thermodynamics as applied to biological systems
- Identification and classificationof microorganisms.

Text / References:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”,Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley andSons, 2009.
3. D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, “Microbiology”, McGraw Hill Higher Education, 2005.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid-exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-CS402P	Computer Organization &Architecture Lab	0L:0T:4P	2 Credits

List of Experiments

1. To study Half Adder.
2. To study Full Adder (7483).
3. To study ALU (74181).
4. Write a program for hexadecimal addition and multiplication.
5. Write a program for binary multiplication.
6. Write a program for Booth's multiplication.
7. Write programs to simulate memory allocation policies
    a. First-fit algorithm
    b. Best-fit algorithm
8. Write programs to simulate the mapping techniques of Cache memory.
    a. Direct Mapped cache
    b. 2 Associative Mapped cache
    c. Set Associative Mapped cache
9. Write a program to implement stack and branch instructions.
10. Design of 4-bit Universal Shift Registers using D-FF.

PCC-CS403P	**Operating Systems Lab**	**0L:0T:4P**	**2 Credits**

List of Experiments

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Write a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Banker's algorithm for deadlock avoidance.

PCC-CS404P	**Design and Analysis of Algorithms Lab**	**0L:0T:4P**	**2 Credits**

List of Experiments

1. Write a Program to implement Insertion sort.
2. Write a Program to implement Binary Search using Divide and Conquer.
3. Write a Program to implement Quicksort.
4. Write a Program to implement shortest path algorithm.
5. Write a Program to implement Merge sort using Divide and Conquer.
6. Write a Program to implement Knapsack problem using Greedy method.
7. Write a Program to implement Prim's algorithm using Greedy method.
8. Write a Program to implement Kruskal's algorithm using Greedy method.
9. Write a Program to implement Graph Traversal: Breadth First Traversal.
10. Write a Program to implement Graph Traversal: Depth First Traversal.
11. Write a Program to implement 8-Queen's problem using Backtracking.
12. Write a Program to implement All Pairs Shortest Path Using Dynamic Programming.

Course Code: ESC501 **Course Name:** Signals and System
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Description:
This course covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). Applications are drawn broadly from engineering and physics, including feedback and control, communications, and signal processing.

Course Content:-
UNIT 1 Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

UNIT 2 Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response,

UNIT 3 Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases,

UNIT 4 The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

UNIT 5 The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

UNIT 6 State-space analysis and multi- input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Course Learning Outcomes(CLO):-

At the end of this course students will demonstrate the ability to

- CO1: Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.

- CO2: Analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
- CO3: Classify systems based on their properties and determine the response of LSI system using convolution.
- CO4: Analyze system properties based on impulse response and Fourier analysis.
- CO5: Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
- CO6: Understand the process of sampling and the effects of under sampling.

Text books:

1. A.Anand Kumar, "Signals and Systems", Second edition, PHI Learning Private Limited,2012.
2. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

Reference books:

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
2. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
3. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
4. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
5. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
6. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
7. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC CS 501 **Course Name:** Database Management System

Course Credit Hour: 3 **Total Contact Hour:** 55hr

Course Objective:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data ware housing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Description:

Focuses on concepts and structures necessary to design and implement a database management system. Various modern data models, data security and integrity, and concurrency are discussed. An SQL database system is designed and implemented as a group project.

Course Contents:

Module 1: Database system architecture: DataAbstraction,DataIndependence,DataDefinition Language(DDL), Data Manipulation Language(DML).

Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulationoperations.

Module 2: Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver.

Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Losslessdesign.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Module 3: Storage strategies: Indices, B-trees, hashing.

Module 4: Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

Module 5: Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

Module 6:

Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Course Learning Outcomes (CLOs):

CLO1. For a given query write relational algebra expressions for that query and optimize the developed expressions

CLO2. For a given specification of the requirement design the databases using E R method and normalization.

CLO3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.

CLO4. For a given query optimize its execution using Query optimization algorithms

CLO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

CLO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Text books :

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts" , 6th Edition, McGraw-Hill, 9780078022159, 0078022150.

Reference books :

1 J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer SciencePress, 788175155459, 8175155450

2 R. Elmasri and S. Navathe, "Fundamentals of Database Systems" , 5th Edition, PearsonEducation 9788131716250, 8131716252

3 Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley "Foundations of Databases", 9780201537710, 0201537710

Online links for study & reference materials:

https://www.geektonight.com/database-management-systems-notes-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS502 **Course Name:** Formal Languages and Automata

Course Credit Hour: 3hr **Total Contact Hour:** 35 hr

Course Objective:

- Develop a formal notation for strings, languages and machines.
- Design finite automata to accept a set of strings of a language.
- Prove that a given language is regular and apply the closure properties of languages.
- Design context free grammars to generate strings from a context free language and convert them into normal forms.
- Prove equivalence of languages accepted by Push down Automata and languages generated by context free grammars
- Identify the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and Undecidability.

Course Description:

- The course introduces fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.

Course Contents:

Unit – I Introduction; Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition tabl e, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transi ion, Language of NFA, Equi valence of NFA and DFA, Minimization of Finite Automata, Distinguis hing one string from other, Myhill-Nerode Theorem

Unit – II Regular expression (RE) , Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages . Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Unit – III Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation , Derivation trees, Ambiguity in Grammer, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Memership, Pumping lemma for CFLs.

Unit – IV Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA

Unit – V Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computerof Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Write a formal notation for strings, languages and machines.
- **CLO-2**: Design finite automata to accept a set of strings of a language.
- **CLO-3**: Determine whether the given language is regular or not.
- **CLO-4**: Design context free grammars to generate strings of context free language.
- **CLO-5**: Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars.

Text books:

- Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education .
- K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
- Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.
- Y.N.Singh "Mathematical Foundation of Computer Science", New Age International.

Reference books:

- K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education.
- Harry R. Lewis and Christos H. Papadimitriou, Elements of the theory of Computation, Second Edition, Prentice-Hall of India Pvt. Ltd.
- Micheal Sipser, "Introduction of the Theory and Computation", Thomson Learning.

Online links for study & reference materials:

- https://nptel.ac.in/courses/106/106/106106049/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam	-	20%
Assignment-4	-	05%
Assignment-5/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code : PCC CS 503

Course Name : Object Oriented Programming

Course Credit Hour : 2

Total Contact Hour : 30

Course Objective: The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, and an appropriate framework for automated unit and integration tests.

Course Description: Object-oriented programming represents the integration of software components into a large-scale software architecture. The course focuses on the understanding and practical mastery of object-oriented concepts such as classes, objects, data abstraction, methods, method overloading, inheritance and polymorphism.

Course Contents:

Module 1: Introduction: The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, importance of modeling, principles of modeling, object oriented modeling, Introduction to UML, conceptual model of the UML, Architecture.

Module II : Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class &Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams, depict a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages.

Basic Behavioural Modeling: Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram.

Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams

Module- III : Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations.

Structured analysis and structured design (SA/SD): Jackson Structured Development (JSD).Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation.

Object oriented programming style: reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation.

Module- IV : Introduction to OOP language: History, Features, Object Oriented concepts, Classes and Objects, Inheritance, Packages, Interface , abstract method and classes, Polymorphism, Inner classes, String Handling, I/O , Networking, Event Handling. Multithreading, Collection, APIs,

Module –V: Swing: Introduction to AWT, AWT v/s Swing, Creating a Swing Applet and Application. Utility of internet programming language, JDBC, The connectivity model, JDBC/ODBC Bridge, Introduction to servlets.

Course Learning Outcomes (CLOs):

CLO1. Specify simple abstract data types and design implementations, using abstraction functions to document them.

CLO2. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.

CLO3. Name and apply some common object-oriented design patterns and give examples of their use.

CLO4. Design applications with an event-driven graphical user interface.

Text books :

1. Liskov, John Guttag, *Program Development in Java*, Addison-Wesley, 2001, 780201657685, 0201657686
2. E Balagurusamy, Programming with Java, McGraw-Hill Education, 9789353162337, 9353162335

Reference books :

1. James Rumbaughet. al, "Object Oriented Modeling and Design", PHI . 9788131711064, 8131711064
2. Mark Priestley "Practical Object-Oriented Design with UML", TMH .
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Pearson Education . 9788177583724, 8177583727
4. Naughton, Schildt, "The Complete Reference JAVA2", TMH .

Online links for study & reference materials:

https://sites.google.com/a/mes.ac.in/oopm/lecture-notes

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 501

Course Name: Organization Behavior

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

- The student will acquire knowledge of organizational behavior including workplace environment, leadership skills, and organization management.
- To enhance the understanding of the dynamics of interactions between individuals and the organization. To facilitate a clear perspective to diagnose and effectively handle human behavior issues in Organization and to develop greater insight into their behavior in interpersonal and groups and team.

Course Description:

- This course introduces the fundamental oforganizational behavior includes important insights about motivation, leadership, perception,and learning theories.

Course Contents:

Unit 1:Introduction of OB: (6 lectures)

The concept and nature of OB, need to understand human behavior, Its significance, and impact, Challenges, and opportunities.

Unit 2:Individual dimensions of behavior:(8 lectures)

Individual characteristics, Ability, Values, Attitudes, Formation, Organization related attitude, Relationship between attitude and behavior, Personality, Types, Determinants and traits, learning and Learning theories, Motivation and Motivation theories.

Unit 3:Group behavior and team development: (8 lectures)

Concept of groups and group dynamics, Types of groups, Formal and Informal group, Stages of group development, Group cohesiveness, Group decision making, Concept of team vs group, Types of teams, Managing teams.

Unit 4:Organizational culture and conflict management:(8 lectures)

Organizational culture, Leadership: What is leadership, types of leaders and leadership styles, traits and qualities of an effective leader, managing conflicts, resolution of conflicts, Change management.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of organization and types.

CLO-2: Inculcate skills and understand behavior.

CLO-3: To understand group behavior and emotional development.

CLO-4: To understand organization culture and management.

Textbooks:

(i) Fred Luthans, ―Organizational Behavior‖, 12th Edition, McGraw Hill International Edition
(ii) Stephen P. Robbins, ―Organizational Behavior‖, 12th Edition, Prentice Hall
(iii) Aswathappa K, ―Organizational Behavior (Text, Cases, and Games)‖, Himalaya Publication

Reference books:

1. UdaiPareek, ―Organizational Behavior‖, Oxford University Press

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-CS 501P	**Database Management System Lab**	**0L:0T:4P**	**2 Credits**

<u>LIST OF PROGRAMS</u>

Software Required: Open Source Software - SQL

1. Introduction to MySQL, An exercise on data types in My SQL and DDL commands.
2. Exercise on DML and TCL commands.
3. Exercise on Types of Data Constraints.
4. Exercise on single and multiple table join and using Normalization.
5. Exercise on Order by and Group by Clause and Data arithmetic.
6. Exercise on different functions(Aggregate, math, string)
7. Exercise on Different types of Sub queries.

PCC-CS5033P	**Object Oriented Programming Lab**	**0L:0T:4P**	**2 Credits**

List Of Practical

1. To become familiar with classes that represents entities that can interact with the user.

2. To successfully write simple programs that involve if statements.

3. To gain practice in the use of Boolean operators like && and ||.

4. Write a program to implement 4 types of pyramid.

5. Write a new program called Options that will request that the user enter an integer and then will display the message positive, negative or zero. If the value that was entered was greater than zero, less than zero, or equal to zero, respectively.

6. Write a simple program implement constructor.

7. Write a program to implement inheritance.

8. Write a program to implement function overloading.

Course Code: PCC-CS601 **Course Name:** Compiler Design

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To understand and list the different stages in the process ofcompilation.
- Identify different methods of lexical analysis
- Design top-down and bottom-upparsers
- Identify synthesized and inheritedattributes
- Develop syntax directed translationschemes
- Develop algorithms to generate code for a targetmachine

Course Description:

- The aim is to learn how to design and implement a compiler and also to study the underlying theories. The main emphasis is for the imperative language. Introduction: Phases of compilation and overview.
- Compilers and translators. Algorithms and implementation techniques for type-checking, code-generation and optimization. Students will implement static analysis type checking, and optimization.

Course Contents:

Module 1:**Introduction to Compiling**: Compilers, Analysis-synthesis model, The phases of the compiler, Cousins of the compiler. **Lexical Analysis :**The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, lexical analyzer generator (Lex).

Module II : Syntax Analysis: The role of a parser, Top down Parsing, Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR,CLR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.**Syntax directed translation:** Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions.

Module III: **Type checking** :Type systems, Specification of a simple type checker.
Run time environments: Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables.

Module IV: **Intermediate code generation** :Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples). **Code optimization** :Introduction, Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization. **Code generations** :Issues in the design of code generator, Register allocation & assignment.

Course learning outcomes:

1. For a given grammar specification develop the lexical analyser
2. For a given parser specification design top-down and bottom-up parsers
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

Suggested books:

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman.- Compilers Principles, Techniques, and Tools, 2nd Edition, Pearson Education, New Delhi, 2006

Suggested reference books:

1. A.I.Holub -Compiler Design in C, Prentice Hall of India, New Delhi, 1995
2. J.P. Tremblay - The Theory and Practical of Compiler Writing, McGraw Hill, Singapore, 1993.
3. K.C. Louden- Compiler Construction: Principles and Practice, Thomson Learning, New Delhi, 2005.
4. Chattopadhyay , S- Compiler Design (PHI)

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-CS602

Course Name: Computer Networks

Course Credit Hour: 3hr

Total Contact Hour: 35hr

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Description:

- The course covers the basic and advanced concepts and techniques of Computer Networks from both theoretical and practical perspective. The material includes Data communication Components, Data Link Layer and Medium Access Sub Layer, Network Layer, Transport Layer and Application Layer. The students will be able to understand almost all algorithms required to understand real world network issues.

Course Contents:

Unit-1

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit-2

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA.

Unit-3

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routingprotocols.

Unit-4

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-5:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Course Learning Outcomes (CLOs):

- **CLO-1**: Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- **CLO-2:** For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.

- **CLO-3**: For a given problem related TCP/IP protocol developed the network programming.
- **CLO-4**: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text books:

- BehrouzA. Frozen, Data Communication and Networking, 4th Edition, McGraw- Hill.
- William Stallings, Data and Computer Communication, 8th Edition, , Pearson Prentice Hall India.

Reference books:

- Andrew S. Tanenbaum , Computer Networks, 8th Edition, , Pearson New International Edition.
- Douglas Comer , Internetworking with TCP/IP, Volume 1, 6th Edition , Prentice Hall of India.
- Richard Stevens , TCP/IP Illustrated, Addison-Wesley, United States o f America.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105183/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Mid-Term Exam)	-	20%
Assignment-3	-	05%
Assignment-1/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: OEC 001 **Course Name:** Soft skills and interpersonal Communication

Course Credit Hour:3Hr **Total Contact Hour:**20hr

Course Objective:

- The student will acquire knowledge of soft skills including motivation, leadership and interview skills.

Course Description:

- This course introduces the fundamental ofsoft skills and hard skills, it includes important insights about motivation, leadership, attitude, stress management and interpersonal communication.

Course Contents:

Unit 1: Soft Skills: An Introduction:

Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. **Self-Discovery:** Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Positivity and Motivation:

UNIT -2: Interpersonal Communication:

Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships7through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.**Public Speaking:** Skills, Methods, Strategies and Essential tips for effective public speaking. Group Discussion: Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective.**Non-Verbal Communication:** Importance and Elements; Body Language. **Teamwork and Leadership Skills:** Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.

UNIT -3: Interview Skills: Interviewer and Interviewee:

Resume writing in-depth perspectives. Before, During and After the Interview. Tips for Success. Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness. Etiquette and Manners – Social and Business. Time Management – Concept, Essentials, Tips.

UNIT – 4: Decision-Making and Problem-Solving Skills:

Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict **Management: Conflict -** Definition, Nature, Types and Causes; Methods of Conflict Resolution. **Stress Management: Stress -** Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress**Leadership and Assertiveness Skills:** A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behavior; Assertiveness Skills.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of soft skills

CLO-2: Inculcate leadership and motivational skills.

CLO-3: To understand perception, emotional development and interview skills.

CLO-4:To understand group development and leadership skills

Text books:

(i) Managing Soft Skills for Personality Development –edited by B.N. Ghosh, McGraw Hill India, 2012.
(ii) English and Soft Skills – S.P. Dhanavel, Orient Black swan

Reference books:

(i) Raman, Singh – Business communication – Oxford Press
(ii) Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-CS601 P	**Compiler Design**	**0L:0T: 4P**	**2 credits**

LIST OF EXPERIMENTS

1. Write a program to check whether string is accepted or not for entered grammar.
2. Write a program to convert infix to postfix notation.
3. Write a program to convert infix to prefix notation.
4. Write a program to convert regular expression of NFA.
5. Write a program to convert NFA to DFA.
6. Write a program to calculate LEADING and TRAILING of a grammar.
7. Write a program to calculate FIRST and FOLLOW of a grammar.
8. Write a program to implement shift reduce parser.
9. Write a program to implement top down parser.

PCC-CS602 P	**Computer Networks**	**0L:0T: 4P**	**2 credits**

List of Experiments

1. Study of different types of Network cables and practically implements the cross wired cable and straight through cable using clamping tool.

2. To implement & study the peer to peer connection using Cisco packet tracer.

3. To implement & study the bus topology using Cisco packet tracer.

4. To implement & study the star topology using Cisco packet tracer.

5. To implement & study the ring topology using Cisco packet tracer.

6. To implement & study the mesh topology using Cisco packet tracer.

7. To implement and configuration the given network topology having single router through graphical user interface using Cisco Packet Tracer.

8. To implement and configuration the given network topology having single router through command line interface using Cisco Packet Tracer.

9. To implement and configuration the given network topology having multiple routers through graphical user interface using Cisco Packet Tracer.

10. To implement and configuration the given network topology having multiple routers through command line interface using Cisco Packet Tracer.

Course Code: OEC-002

Course Name: Human Resource Development

Course Credit Hour:3Hr

Total Contact Hour:30hr

Course Objective:

- The objective of the course is to make student aware of the concepts, techniques and practices of human resource development. This course is intended to make students capable of applying the principles and techniques as professionals for developing human resources in an organization.

Course Description:

- This course introduces the fundamental of human resource development includes important insights about the human resource process, Organization development, Training methods, and training development.

Course Contents:

Unit 1:HRD-Macro Perspective:(6 lectures)

HRD Concept, Origin, and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate.

Unit 2:HRD–Micro Perspective: (6 lectures)

Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD

Unit 3:Instructional Technology for HRD:(6 lectures)

Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behavior Modeling and Self-Directed Learning; Evaluating the HRD

Unit 4: Human Resource Training and Development: (6 lectures)

Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programs; Role, Responsibilities, and challenges to Training Managers.

Unit 5:Training Methods:(6 lectures)

Training within Industry (TWI): On the Job & Off the Job Training; Management Development: Lecture Method; Role Play; In-basket Exercise; Simulation; Vestibule Training; Management Games; Case Study; Programmed Instruction; Team Development; Globalization challenges and Strategies of Training Program, Review on T&D programs in India.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human resources.

CLO-2: Inculcate cultural and learning skills.

CLO-3: To understand learning methods and their importance.

CLO-4:To understand the need for training.

CLO-5:To develop training methods.

Textbooks:

1. Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi, 2005.
2. Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.
3. Rao, T.V: Readings in HRD, Oxford IBH Pub. Pvt. Ltd., New Delhi, 2004.
4. Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.

Reference books:

1. Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.
2. Virmani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: OEC003

Course Name: Cyber Law & Ethics

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

- To understand Cyber Laws and its evolution in Computer Technologies
- To Understand and analyze Information Technology Act.
- To understand cyber laws and related Legislation.
- To understand electronics business and legal issues associated with it.
- Study based on Cyber crime.

Course Description:

- Write a brief summary indicating how this will be conducted specifying the key topics of the whole course.
- Write about 4 to 5 lines or till 7 lines, if some course description demands.

Course Contents:

UNIT – I

Introduction to Cyber Law Evolution of Computer Technology : Emergence of Cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

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UNIT – II

Information technology Act : Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

UNIT – III

Cyber law and related Legislation : Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

UNIT – IV

Electronic Business and legal issues: Evolution and development in E- commerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security. **Application area:** Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.

UNIT – V

Case Study On Cyber Crimes: Harassment Via E-Mails, Email Spoofing (Online A Method Of Sending E-Mail Using A False Name Or E-Mail Address To Make It Appear That The E-Mail Comes From Somebody Other Than The True Sender, Cyber Pornography (Exm.MMS),Cyber-Stalking.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to

- CLO-1: Understand the concept of cyber law and it evolution in computer technology
- CLO-2: Understand Information Technology Act in detail.
- CLO-3: Understand cyber laws and related Legislation.
- CLO-4: Relate electronics business with its legal issues associated with cyber laws.
- CLO-5: Understand real problems through case studies based on cyber law incidents.

Text books:

- K.Kumar "Cyber Laws :Intellectual Property & E Commerce Security, Dominant Publisher
- Rondey D. Ryder, Guide to Cyber Laws, Wadhwa & Company, New Delhi.
- Information Security Policy & Implementation Issues, NIIT, PHI.

Reference books:

- Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, Edition, PHI.
- Sharma, S.R., "Dimensions Of Cyber Crime", Annual publications Pvt. Ltd-2004

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106129/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam)	-	20%
Assignment-3	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

LIST OF ELECTIVES

Thread 1: Theory & Algorithms		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-T 501	Graph Theory
Elective II	PEC-CS-T 601	Advanced Algorithms
Elective III	PEC-CS-T 602	Parallel & Distributed Algorithms
Elective IV	PEC-CS-T 701	Computational Complexity
Elective V	PEC-CS-T 702	Computational Complexity
Elective VI	PEC-CS-T 703	Queuing Theory & Modeling
Additional Subject (can replace with any elective from the same thread): Theory Of Computation		

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Thread 2: Systems		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-S 501	Advanced Computer Architecture
Elective II	PEC-CS-S 601	Software Engineering
Elective III	PEC-CS-S 602	Distributed Systems
Elective IV	PEC-CS-S 701	Embedded Systems
Elective V	PEC-CS-S 702	Advanced Operating Systems
Elective VI	PEC-CS-S 703	Low Power Circuit & Systems
Additional Subject (can replace with any elective from the same thread): Fault Tolerant Computing		

Thread 3: Data Science & Machine Intelligence		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-D 501	Artificial Intelligence
Elective II	PEC-CS-D 601	Machine Learning
Elective III	PEC-CS-D 602	**Data Mining
Elective IV	PEC-CS-D 701	Soft Computing
Elective V	PEC-CS-D 702	Speech and Natural Language Processing
Elective VI	PEC-CS-D 703	**Data Analytics

Thread 4: Applications		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-CS-A 501	Image Processing
Elective II	PEC-CS-A 601	Digital Signal Processing
Elective III	PEC-CS-A 602	**Cloud Computing
Elective IV	PEC-CS-A 701	Human Computer Interaction
Elective V	PEC-CS-A 702	Electronic Design Automation
Elective VI	PEC-CS-A 703	Computer Graphics

Thread 1: Theory & Algorithms

Course Code: PEC-CS-T 501 **Course Name: Graph Theory**
Course Credit: 3 **Total Contact Hour:** 42 HRS

Course Objective:

Graph Theory is one of the essential tools for learning Technology, Engineering and Sciences. In this course students will come across several theorems and proofs. This course is aimed to cover a variety of different problems in Graph Theory. Theorems will be stated and proved formally using various techniques.

Course Description:

Graph theory is a study of graphs, trees and networks. Topics that will be discussed include Euler formula, Hamilton paths, planar graphs and coloring problem; the use of trees in sorting and prefix codes; useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm

Course Contents:

Unit-I

Predicate Calculus: Proposition, Logical operators and expressions, predicates, Rules of quantifiers. Rules of Inference for propositions and predicates.

Unit-II

Lattices: Relation, Poset, Hasse diagram, Lattice as Poset Properties of lattices, Lattice as an algebraic system, Duality.

Unit-III

Concepts of Graphs and Trees: Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees Spanning and Minimal spanning trees

Unit-IV

Matrix representations and Graph Algorithms: Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs: 1 and 2-isomorphism Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, prims and Kruskal.

Unit-V

Planar graphs and their properties: Planarity of graphs, Planar graphs Stereographic projection and embedding on a sphere Kurtowski's two graphs, Euler's formula, Detection of planarity and elementary reduction

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Apply concept of Predicate Calculus in computer science like design of computing machines, artificial intelligence, definition of data structures for programming languages etc. (Application)
- Understand the concepts of graph theory, Lattices, and Boolean Algebrain analysis of various computer science applications. (Knowledge, Comprehension)

- Apply the knowledge of Boolean algebra in computer science for its wide applicability in switching theory, building basic electronic circuits and design of digital computers. (Knowledge, Application)

Text books:

- Rosen Kenneth: Discrete mathematics and its applications. McGraw hill- New Delhi. 2. Stanat and McAlister: Discrete Mathematics for Computer Science, PHI

Reference books:

- Kolman and R.C. Busby: Discrete mathematical structures for computer science Prantice Hall, New-Delhi.
- J.P. Tremblay and Manohar: Discrete mathematical structures with application to Computer Science, McGraw hill- New Delhi.

Online links for study & reference materials:

https://nptel.ac.in/courses/111/106/111106102/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PEC- CS-T 601 **Course Name:** Advanced Algorithms
Course Credit: 3 **Total Contact Hour:** 42hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description:

This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. There will also be a brief introduction to complexity theory, the formal study of algorithm performance. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Course Contents:

Unit-I

Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis..

Unit-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations,LUP-decomposition

Unit-IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programmingparadigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Unit-VI

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyze worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Text books:

- Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. Algorithms. McGraw-Hill, 2006. ISBN: 9780073523408.
- Kleinberg, Jon, and Eva Tardos. Algorithm Design. Addison-Wesley, 2005. ISBN: 9780321295354.

Reference books:

- Even, Shimon. *Graph Algorithms*. Computer Science Press, 1979. ISBN: 9780914894216.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105157/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PEC- CS- T 602 **Course Name:** Parallel & Distributed Algorithms

Course Credit Hour: 3 **Total Contact Hour**: 60hr

Course Objective:

- To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
- To study the main classes of parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.

Course Description:

This course will cover widely used parallel and distributed computing methods, including threaded applications, GPU parallel programming, and datacenter-scale distributed methods such as MapReduce and distributed graph algorithms. We'll study the types of algorithms which work well with these techniques, and have the opportunity to implement some of these algorithms. We'll also look at the types of hardware architectures which have been developed along with these computing methods.

Course Contents:

UNIT-I

Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing

UNIT-II

Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples

UNIT-III

Pipelining- Techniques computing platform, pipeline programs examples

UNIT-IV

Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP

UNIT-V

Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms

Course Learning Outcomes (CLOs):

CLO-1: Learn about parallel and distributed computers.
CLO-2: Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library
CLO-3: Analytical modeling and performance of parallel programs
CLO-4: Analyze complex problems with shared memory programming with OpenMP.

Text books:

- Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.

Reference books:

Introduction to Parallel algorithms by Jaja from Pearson, 1992.

Online links for study & reference materials:

https://www.britannica.com/science/computer-science/Parallel-and-distributed-computing

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-CS-T 701 **Course Name: Computational Complexity**

Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

Computational complexity theory is the fundamental subject of classifying computational problems based on their complexities'. In this context, `complexity' of a problem is a measure of the amount of resources

Course Description:

Computational complexity aims to understand the fundamental limitations and capabilities of efficient computation. We will use the powerful notions of reduction and completeness to establish relationships between seemingly unrelated problems, classes, and resources.

Course Contents:

Unit-I

Introduction: Easy and hard problems. Algorithms and complexity. Turing machines: Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems

Unit-II

The Halting Problem and Undecidable Languages: Counting and diagonalization. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem. Deterministic Complexity Classes: DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability.

Unit-III

NP and NP-completeness: Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NP-completeness. Cook-Levin Theorem. Polynomial transformations: 3- satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.

Unit-IV

Space complexity and hierarchy theorems: DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NLcompleteness. NL=coNL. Hierarchy theorems

Unit-V

Optimization and approximation: Combinatorial optimization problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, traveling salesman problem, minimum partition.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Determine whether a problem is computable, and prove that some problems are not computable
- Categorize problems into appropriate complexity classes
- Classify problems based on their computational complexity using reductions
- Analyze optimization problems using the concept of interactive proofs

Text books:

- Michael Sipser, Introduction to the Theory of Computation, (First edition - PWS Publishing Company, January 1997, or second edition - Thomson Course Technology, 2005).
- Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press,2009

Reference books:

- Oded Goldreich, Computational Complexity, Cambridge University press, 2008.
- Vijay Vazirani, Approximation Algorithms, Springer--Verlag, 2001

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106229/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-T 703

Course Name: Queuing Theory & Modeling

Course Credit: 3

Total Contact Hour: 40

Course Objective:

The objective of a queuing model is to find out the optimum service rate and the number of servers so that the average cost of being in queuing system and the cost of service are minimized. The queuing problem is identified by the presence of a group of customers who arrive randomly to receive some service.

Course Description:

This course deals with the modeling and analysis of queuing systems, with applications in communications, manufacturing, computers, call centers, service industries and transportation. Topics include birth-death processes and simple Markovian queues, networks of queues and product form networks

Course Contents:

Unit-I

Queueing Theory: Introduction of the queuing system, Various components of a queueing system. Permutations, combinations,

Unit-II

counting, summation, generating function, recurrence relations, asymptotic. Sample space and events- Probability- The axioms of probability

Unit-III

Queuing theory- Classification, stationary process, markov process, Binomial process, Poisson process, Birth and death process, Markov chain.

Unit-IV

Markovian and non-Markovian queueing systems, embedded Markov chain applications to M/G/1, G/M/1 and related queueing systems; Networks of queues, open and closed queueing networks; Queues with vacations,

Unit-V

Priority queues, queues with modulated arrival process, discrete time queues, introduction to matrix-geometric methods, applications in manufacturing, computer and communication networks.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Single Server Markov Queues.
- Rigorous understanding of the theoretical background of queuing systems.
- Introduction to Queuing Systems and Notation.
- Understand and compute quantitative metrics of performance for queuing systems.
- Apply and extend queuing models to analyze real world systems.

Text books:

- D. Gross and C. Harris, Fundamentals of Queueing Theory, 3rd Edition, Wiley, 1998. (WSE Edition, 2004).
- J. Medhi, Stochastic Models in Queueing Theory, 2nd Edition, Academic Press, 2003. (Elsevier India Edition, 2006).

Reference books:

- Saaty, T.L. (1984): Elements of Queueing Theory with applications, McGraw Hill, New York.
- Jain, J.L., Mohanty, S.G. and Bohm, W. (2006): A Course on Queueing Models, Chapman & Hall/CRC.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/103/117103017/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Thread 2: Systems

Course Code: PEC-CS-S 501 **Course Name: Advanced Computer Architecture**
Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

- Understand the Concept of Parallel Processing and its applications.
- Implement the Hardware for Arithmetic Operations.
- Analyze the performance of different scalar Computers.

Course Description:

This course is a study of the fundamental concepts in the design and organization of modern computer systems. The module aims to provide students with a fundamental knowledge of computer hardware and computer systems, with an emphasis on system design and performance.

Course Contents:

Unit-I

Pipeline and vector processing : Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

Unit-II

Computer Arithmetic : Addition and Subtraction, Hardware Implementation, Multiplication Algorithms and Hardware Implementation, Division Algorithms and Hardware Implementation, Floating Point Arithmetic Operations.

Unit-III

Parallel Computer Models : Evolution of Computer Architecture, System Attributes to Performance, Shared Memory Multiprocessors, Distributed Memory Multicomputers, Vector Super Computers, SIMD Super Computers.

Unit-IV

Processors and Memory Hierarchy : Advanced Processor Technology: Design Space of Processors, Instruction-Set Architectures, CISC scalar Processors, RISC scalar Processors, Super Scalar and Vector Processors: Superscalar Processors.

Unit-V

Pipelining and Superscalar Techniques : Linear Pipeline Processors: Asynchronous and Synchronous models, Clocking and Timing Control, Speedup, Efficiency and Throughput, Pipeline Schedule Optimization, Instruction Pipeline Design: Instruction Execution Phases, Mechanisms for Instruction Pipelining, Dynamic Instruction Scheduling, Branch Handling Techniques.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the Concept of Parallel Processing and its applications
- Implement the Hardware for Arithmetic Operations
- Analyze the performance of different scalar Computers
- Develop the Pipelining Concept for a given set of Instructions

Text books:

- Computer System Architecture, Morris M. Mano, 3rd edition, Pearson/Prentice Hall India.
- Advanced Computer Architecture, Kai Hwang, McGraw-Hill, India.

Reference books:

- Computer Organization and Achitecture, William Stallings ,8th edition,PHI
- Computer Organization, Carl Hamachar, Vranesic,Zaky, 5th edition, McGraw Hill.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102229/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 601 **Course Name: Software Engineering**

Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

- To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
- To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Description:

The basic objective of software engineering is to develop methods and procedures for software development that can scale up for large systems and that can be used consistently to produce high-quality software at low cost and with a small cycle of time.

Course Contents:

Unit-I

Introduction to Software Engineering, Software Components, 8 Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative

Unit-II

Software Requirement Specifications (SRS)

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document.

Unit-III

Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Unit-IV

Software Testing:Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies:

Unit-V

Software Maintenance and Software Project Management 8 Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO)

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Students will be able to decompose the given project in various phases of a lifecycle.
- Students will be able to choose appropriate process model depending on the user requirements
- Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance
- Students will be able to know various processes used in all the phases of the product.

Text books:

- R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
- Rajib Mall, Fundamentals of Software Engineering, PHI Publication.

Reference books:

- K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
- Pankaj Jalote, Software Engineering, Wiley
- Deepak Jain,"Software Engineering:Principles and Practices",Oxford University Press

.**Online links for study & reference materials:**

https://nptel.ac.in/courses/106/105/106105182/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 602 **Course Name:** Distributed Systems

Course Credit Hour: 3 **Total Contact Hour**: 40hr

Course Objective:

To provide hardware and software issues in modern distributed systems.

• To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

• To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Course Description: This course provides a hands-on the challenges faced in constructing client/server software: partial system failures, multiple address spaces, absence of a single clock, latency of communication, heterogeneity, absence of a trusted operating system, system management, binding and naming. Techniques for meeting these challenges: RPC and middleware, naming and directory services, distributed transaction processing, 'thin' clients, data replication, cryptographic security, mobile code. Introduction to Java RMI.

Course Contents:

Unit I

Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. TheoreticalFoundation for Distributed System: Limitation of Distributed system, absence of global clock,shared memory, Logical clocks, Lamport's& vectors logical clocks. Concepts in Message PassingSystems: causal order, total order, total causal order, Techniques for Message Ordering, Causalordering of messages, global state, termination detection.

Unit II

Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement ofmutualexclusion theorem, Token based and non-token-based algorithms, performance metric fordistributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resourceVs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralizeddead lock detection, distributed dead lock detection, path pushing algorithms, edge chasingalgorithms.

Unit III

Agreement Protocols: Introduction, System models, classification of Agreement Problem,Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution toByzantine Agreement problem, Application of Agreement problem, Atomic Commit in DistributedDatabase system. Distributed Resource Management: Issues in distributed File Systems,Mechanism for building distributed file systems, Design issues in Distributed Shared Memory,Algorithm for Implementation of Distributed Shared Memory.

Unit IV

Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems.Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Unit V

Transactions and Concurrency Control: Transactions, Nested transactions, Locks, OptimisticConcurrency control, Timestamp ordering, Comparison of methods for concurrency control.Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Course Learning Outcomes (CLOs):

CO1: To provide hardware and software issues in modern distributed systems.

CO2: To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3: To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

CO4: To know about Shared Memory Techniques.

CO5: Have Sufficient knowledge about file access.

Text books:

1. Singhal&Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill

2. Ramakrishna,Gehrke," Database Management Systems", McGraw Hill

3. Vijay K.Garg Elements of Distributed Compuitng , Wiley

4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", PearsonEducation

5. Tenanuanbaum,Steen," Distributed Systems", PHI

Reference books:

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.

2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor &Fransis Group, 2007.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-CS-S 701
Course Credit: 3

Course Name: Embedded Systems
Total Contact Hour: 40hr

Course Objective :

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Description :

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

Course Contents :

Unit 1

Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit 2

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit 3

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit 4

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit 5

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Course Learning Outcomes (CLOs) :

- CLO1: Expected to understand the selection procedure of Processors in the Embedded domain.
- CLO2: Design Procedure for Embedded Firmware.
- CLO 3: Expected to visualize the role of Real time Operating Systems in Embedded Systems
- CLO 4. Expected to evaluate the Correlation between task synchronization and latency issues

Text books:

- Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference books:

- Embedded Systems - Raj Kamal, TMH.
- Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
- Embedded Systems – Lyla, Pearson, 2013
- An Embedded Software Primer - David E. Simon, Pearson Education.

Online links for study & reference materials :

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/106/105/106105193/

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 702

Course Name : Advanced Operating System

Course Credit Hour : 3

Total Contact Hour : 30hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

ModuleI FUNDAMENTALS OF OPERATING SYSTEMS

Overview –Synchronization Mechanisms , Processes and Threads , Process Scheduling , Deadlocks: Detection, Prevention and Recovery, Models of Resources, Memory Management Techniques.

ModuleII DISTRIBUTED OPERATING SYSTEMS

Issues in Distributed Operating System , Architecture , Communication Primitives , Lamport's Logical clocks, Causal Ordering of Messages, Distributed Mutual Exclusion Algorithms, Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols.

ModuleIII DISTRIBUTED RESOURCE MANAGEMENT

Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery, Fault Tolerance , Two-Phase Commit Protocol, Non blocking Commit Protocol , Security and Protection.

ModuleIV REAL TIME AND MOBILE OPERATING SYSTEMS

Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems , Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management , File system.

ModuleV CASE STUDIES

Linux System: Design Principles , Kernel Modules, Process Management Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication. iOS and Android: Architecture and SDK Framework , Media Layer, Services Layer, Core OS Layer, File System.

Course Learning Outcomes (CLOs):

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.

4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Text books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 703
Course Credit: 3

Course Name: Low Power Circuit & Systems
Total Contact Hour: 40hr

Course Objective:

- To learn fundamentals of power dissipation in microelectronic devices.
- To identify system performance and reliability

Course Description:

This course deals with issues and models to design low-power VLSI circuits, fundamentals of power dissipation in microelectronic devices, will be able to estimate power dissipation due to switching, short circuit.

Course Contents:

Unit 1

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degreeoffreedom, recurring themes in low-power, emerging low power approaches, dynamicdissipation in CMOS, effects of Vdd& Vt on speed, constraints on Vt reduction, transistorsizing & optimal gate oxide thickness, impact of technology scaling, technologyinnovations.

Unit 2

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, highcapacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3

Low Power Clock Distribution: Power dissipation in clock distribution, single driverversusdistributed buffers, buffers & device sizing under process variations, zero skew vs.tolerableskew, chip & package co-design of clock network.

Unit 4

Logic Synthesis for Low Power estimation techniques: Power minimization techniques,lowpower arithmetic components- circuit design styles, adders, multipliers.

Unit 5

Low Power Memory Design: Sources & reduction of power dissipation in memorysubsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits,low power SRAM circuits.

Unit 6

Low Power Microprocessor Design System: power management support, architecturaltradeoffs for power, choosing the supply voltage, low-power clocking, implementation problemfor low power, comparison of microprocessors for power & performance.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
- Characterize and model power consumption & understand the basic analysis methods.
- Understand leakage sources and reduction techniques.

Text books:

- Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.

Reference books:

- P. Rashinkar, Paterson and L. Singh, "Low Power Design Methodologies", Kluwer Academic, 2002
- Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", John Wiley sons Inc.,2000.
- J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley, 1999.
- A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995

Online links for study & reference materials:
https://nptel.ac.in/courses/117/101/117101004/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Thread 3: Data Science & Machine Intelligence

Course Code: PEC-CS-D 501

Course Name : Artificial Intelligence

Course Credit Hour: 3

Total Contact Hour : 42hr

Course Objective: The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environments.

Course Description: Artificial intelligence (AI) is a research field that studies how to realize the **intelligent** human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously.

Course Contents:

Module 1: Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Module II: Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games,Alpha - Beta pruning.

Module III: Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Module IV: Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning,

Module V: Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Course Learning Outcomes (CLOs):

1) Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

2) Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

3) Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

4) Demonstrate profciency developing applications in an 'AI language', expert system shell, or data mining tool.

5) Demonstrate profciency in applying scientifc method to models of machine learning.

6) Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

Text books :

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”,McGraw-Hill
2. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, PearsonEducation Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall ofIndia,

Reference books :

1. A Modern Approach Third Edition Stuart Russell and Peter Norvig, 2010. Pearson Education, Inc. ISBN: 978-0-13-604259-4
2. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, PearsonEducation

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-D601

Course Name: Machine Learning

Course Credit Hour: 3hr

Total Contact Hour: 40hr

Course Objective:

- The course aims to provide basic understanding of issues and challenges of Machine Learning. It aims to train the student to the basic and advanced models and algorithms of the core field of machine learning. This course also involves understanding of the strengths and weaknesses of many popular machine learning approaches.

Course Description:

- The course covers the basic concepts and techniques of Machine Learning from both theoretical and practical perspective. The material includes Introduction to machine learning and different types of learning, Linear Regression, Decision Trees, Instance based learning, Feature Selection, Neural Network, Clustering and Support Vector Machines. The students will be able to understand almost all algorithms required to develop ML applications.

Course Contents:

Unit-1: Introduction to machine learning and different types of learning: Brief Introduction to Machine Learning; Definition, Components of a learning problem, Applications, Choosing a Model Representation, Types of learning: Supervised Learning, Unsupervised Learning, Semi-supervised learning, Reinforcement Learning, Inductive Learning or Prediction,

Unit-2: Linear Regression and Decision Trees, Instance based learning and Feature Selection: Regression, Types of Regression Models (Linear Classification, Logistic Regression, Components Regression, Bias – Variance Linear Regression Multivariate Regression etc), Dimensionality Reduction Subset Selection, Shrinkage Methods, Principle Linear Discriminant Analysis Optimization, Classification-Separating Hyperplanes Classification, LMS Algorithm, Decision Tree, Over fitting, Instance- Based Learning, Basic k-nearest neighbor classification, kNN, Euclidean Distance, Feature Reduction in ML, Subset selection, Feature extraction, PCA

Unit-3: Probability and Bayes Learning, Support Vector Machines, Clustering: Probability for Learning, Bayes Theorem, MAP Learner, Naïve Bayes, Bayesian Network, Logistic Regression for classification, Support Vector Machines, Unsupervised learning, Partitioning Algorithms, Hierarchical Clustering, Density based Clustering, K-means algorithm.

Unit-4: Neural Network: Neuron, ANNs, Perceptrons, Gradient Descent, Early models, Back propagation, Initialization, Training & Validation, Parameter Estimation (Maximum Likelihood Estimation, Bayesian Parameter Estimation) Decision Trees Evaluation Measures, Hypothesis Testing Ensemble Methods, Graphical, Deep Learning, Deep Neural Network, Hierarchical Representation, Unsupervised Pre-training, Activation Functions.

Unit-5: Clustering, Gaussian Mixture Models, Spectral Clustering Ensemble Methods Learning Theory, Reinforcement Learning.

Course Learning Outcomes (CLOs):

On completion of the course students will be expected to

- **CLO-1**: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity etc,

- **CLO-2**: Have an understanding of the strength and weaknesses of many popular machine learning approaches.
- **CLO-3**: Appreciate the underlying mathematical relationship within and across Machine Learning Algorithms and the paradigm of supervised and un-supervised learning.
- **CLO-4**: Be able to design various machine learning algorithms in a range of real world applications.

Text books:

- Alpaydin E, Machine Learning, MIT Press.
- Bishop C, Pattern Recognition and Machine Learning, Springer-2006.
- Duda R, Hart E and Stork D, Pattern Classification, Wiley-Interscience.
- Mitchell T, Machine Learning, McGraw-Hill.

Reference books:

- Hastie T, Tibshirani R and Friedman J, Elements of Statistical Learning, Springer-2017.
- T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,
- Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Online links for study & reference materials:

https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-D 602

Course Name: Data Mining

Course Credit Hour: 3hr

Total Contact Hour: 42hr

Course Objective:

- To identify the scope and essentiality of Data Mining.
- To analyze data, choose relevant models and algorithms for respective applications.
- To study spatial and web data mining.
- To develop research interest towards advances in data mining.

Course Description:

- Data mining refers to a set of techniques that have been designed to efficiently find interesting pieces of information or knowledge in large amounts of data.
- In this course we explore how this interdisciplinary field brings together techniques from databases, statistics, machine learning, and information retrieval

Course Contents:

Module 1: **FUNDAMENTALS:** Relation to Statistics – Databases – Data Mining Functionalities – Steps in Data Mining Process– Architecture of Typical Data Mining Systems –Classification of Data Mining Systems– Overview of Data Mining Techniques.

Module 2: DATA PREPROCESSING AND ASSOCIATION RULES

Data Preprocessing – Data Cleaning – Integration – Transformation – Reduction –Discretization Concept Hierarchies – Concept Description Data Generalization and Summarization Based Characterization – Mining Association Rules in Large Databases.

Module 3: PREDICTIVE MODELING

Classification and Prediction Issues Regarding Classification and Prediction –Classification by Decision Tree Induction – Bayesian Classification – Other Classification Methods– Prediction –Clusters Analysis – Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods.

Module 4: DATA WAREHOUSING

Data Warehousing Components – Multi Dimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – Mapping the Data Warehouse to Multiprocessor Architecture – OLAP – Need – Categorization of OLAP Tools.

Course learning outcomes:

- Understand Data Mining data warehouse Principles
- Identify appropriate data mining algorithms to solve real world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Describe complex data types with respect to spatial and web mining.
- Benefit the user experiences towards research and innovation. integration.

Suggested books:

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers, 2002.

Suggested reference books:

1. Alex Berson, Stephen J Smith, “Data Warehousing, Data Mining & OLAP”, Tata Mcgraw Hill, 2004.

2. Usama M. Fayyad, Gregory Piatetsky , Shapiro, Padhrai Smyth and Ramasamy Uthurusamy," Advances In Knowledge Discovery And Data Mining", The M.I.T Press, 1996.

3. Ralph Kimball, "The Data Warehouse Life Cycle Toolkit", John Wiley& Sons Inc., 1998.

4. Sean Kelly, "Data Warehousing In Action", John Wiley & Sons Inc., 1997.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-D 701 **Course Name:** Soft Computing

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

1. To make the student to understand the role of imprecision and uncertainty in real world scenarios.
2. To explain the role of Soft Computing in addressing the imprecision and uncertainty.
3. To explain the principal components of soft computing that include Fuzzy Sets and Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms and Rough Sets.
4. To learn the Design and Implementation of Soft Computing methodologies.
5. To explain the design of hybrid systems which is combination of one or more soft computing methodologies mentioned.

Course Description:

This **course** will provide students the basic concepts of different methods and tools for processing of uncertainty in intelligent systems, such as, **fuzzy** models, **neural networks**, probabilistic models, and foundations of its using in real systems.

Course Contents:

Module 1 Soft Computing: Introduction to Fuzzy Computing, Neural Computing, GeneticAlgorithms, Associative Memory, Adaptive Resonance Theory, Different Tools and Techniques,Usefulness andApplications.

Module 2. Fuzzy Sets and Fuzzy Logic: Introduction, Fuzzy Sets Versus Crisp Sets, Operations on FuzzySets, Extension Principle, Fuzzy Relations and Relation Equations, Fuzzy Numbers, LinguisticVariables, Fuzzy Logic, Linguistic Hedges,Applications,

Module 3. Interference in fuzzy logic: fuzzy if-then rules, Fuzzy implications and Fuzzyalgorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Fuzzy Controllers, FuzzyPattern Recognition, Fuzzy Image Processing, Fuzzy Database. **Artificial Neural Network**: Introduction, Artificial Neuron and its model, activationfunctions, Neural network architecture: single layer and multilayer feed forward networks,re-current networks. Various learning techniques, perception and convergence rule, Auto-associativeand hetro-associative memory , Hebb's Learning, Adaline,Perceptron

Module 4. Multilayer Feed Forward Network: Back Propagation Algorithms, Different IssuesRegarding Convergence of Multilayer Perceptron, Competitive Learning, Self- Organizing, FeatureMaps, Adaptive Resonance Theory, Associative Memories,Applications. **Evolutionary and Stochastic Techniques:** Genetic Algorithm (GA), GeneticRepresentations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis ofSelection Operations, Hypothesis of Building Blocks, Schema Theorem and Convergence ofGenetic Algorithm, Simulated Annealing and Stochastic Models, Boltzmann Machine,Applications.

Module 5. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reductionof Knowledge, Decision Tables and Applications. Hybrid Systems: Neural- Network-BasedFuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Designand Learning, Fuzzy Logic and Genetic Algorithm for Optimization,Applications

Course learning outcomes:

1. Ability to represent Uncertainty / imprecision data.
2. Ability to select a suitable method of Soft Computing to solve a particular problem.

3. Ability to build hybrid systems using Soft Computing techniques.

TextBooks:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S.Rajsekar an and G.A. Vijayalakshmi Pai, Prentice Hall ofIndia.
2. Rough Sets, Z.Pawlak, Kluwer Academic Publisher,1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher,1997

References:

1. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
2. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice HallPTR. Addison-Wesley
3. Learning and Soft Computing, V. Kecman, MIT Press,2001
4. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI,1997

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-D 702 **Course Name:** Speech & Natural Language Processing

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective: This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Course Description: **NLP** tasks in syntax, semantics, and pragmatics. Applications such as **information** extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning.

Course Contents:

Module I Introduction: Knowledge in speech and language processing, Ambiguity, Models and Algorithms, Brief History Regular Expressions and Automata: Regular Expressions, Finite-State Automata, Regular Languages and FSA Morphology and Transducers: Inflectional and derivational morphology, finite state morphological parsing, Combining FST Lexicon and rules. Lexicon free FST: Porter Stemmer N-grams: Counting Words in Corpora, SIMPLE (UNSMOOTHED) N-GRAMS, Smoothing, Entropy HMM and Speech Recognition: Speech Recognition Architecture, Overview of HMM, A* decoding .

Module II Word Classes and Part-of-Speech Tagging: English word classes, Targets for English, Part of speech Tagging, Rule Based part of speech Tagging, Transformation Based Tagging. Context Free Grammars for English: Constituency, Context Free rules and Trees, Sentence level construction, The Noun Phrase, Coordination, Agreement, The verb phrase and sub-categorization. Spoken Language Syntax, Grammar Equivalence and Normal form, Finite state context free grammars, Grammar and human processing. Parsing with context free grammars: Parsing as Search, Basic Top down Parser, Problems with basic top-down-parsers, the early Algorithm, Finite state parsing method Features and Unifications: Feature structures, Unification of Features Structures, Features Structures in the grammar, Implementing Unification. Lexicalized and probabilistic parsing: Probabilistic context free grammars, problems with probabilistic context free grammars, probabilistic lexicalized GFG.

Module III Semantics Representing Meaning: Computational Desiderata for representation, Meaning structure of language, First order predicate calculus, linguistically relevant concept, Related Re-presentational approaches, Alternative approaches to meaning. Semantic Analysis: Syntax driven semantic analysis, Attachment of Fragment of English, Integrating semantic analysis with early parser. Robust Semantic Analysis. Lexical Semantics: Relation among lexemes and their senses, Internal Structure of words.

Module IV Pragmatics Discourse: Reference resolution, Text Coherence, Discourse Structure, Psycholinguistics Studies of reference and coherence. Natural Language generation: Introduction to language generation, Architecture for generation, Surface realization, Discourse planning, Macro planning, Lexical selection, evaluating generation systems, generating speech

Course learning outcomes:

After successful completion of this course, student will be able to

1. Understand approaches to syntax and semantics in NLP.
2. Understand approaches to discourse, generation, dialogue and summarization within NLP.
3. Understand current methods for statistical approaches to machine translation.
4. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP

Text books:

1. Speech and Language processing An introduction to Natural Language Processing, Computational Linguistics and speech Recognition by Daniel Jurafsky and James H. Martin (ISBN13: 978-0131873216)
2. 2. Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Lopper(ISBN13:978-0596516499)

Reference book:

1. Handbook of Natural Language Processing, Second Edition—NitinIndurkhya, Fred J. Damerau, Fred J. Damerau (ISBN13: 978-1420085921)

Online links for study & reference materials:

1. **NPTEL**

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-D 703 **Course Name:** Data Analytics

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSqlMapReduce.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Description:

- This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to make decisions on operations, risk management, finance, marketing, etc.
- Analysis is done targeting economic and financial decisions in complex systems that involve multiple partners. Topics include probability, statistics, hypothesis testing, regression, clustering, decision trees, and forecasting.

Course Contents:

Module 1: Big Data and its Importance– Four V's of BigData– DriversforBigData–IntroductiontoBigDataAnalytics– BigDataAnalyticsapplications, Hadoop's Parallel World–Data discovery Opensourcetechnology for Big Data Analytics–cloud and Big Data–PredictiveAnalytics–MobileBusinessIntelligenceandBigData–CrowdSourcing Analytics–Inter-andTrans-FirewallAnalytics-InformationManagement.

Module2: Integratingdisparatedatastores-Mappingdatatotheprogrammingframework- Connecting and extracting data from storage -Transforming data for processing –SubdividingdatainpreparationforHadoopMapReduce, Hadoop Map Reduce-Creating the componentsofHadoop.

Module3: MapReducejobs-Distributingdataprocessingacrossserverfarms-Executing HadoopMapReducejobs-Monitoringtheprogressofjobflows-TheBuildingBlocksof Hadoop Map Reduce -Distinguishing Hadoop daemons-Investigating the HadoopDistributedFileSystem Selectingappropriateexecutionmodes:local,pseudo-distributed,Fullydistributed.

Module 4: Real-TimeArchitecture–OrchestrationandSynthesisUsingAnalyticsEngines– Discovery using Data atRest– Implementation of Big Data Analytics – Big Data Convergence–AnalyticsBusinessMaturityModel,InstallingandRunningPig–Comparison with Databases–Pig Latin UserDefineFunctions–Data Processing Operators–Installing andRunningHive–HiveQL–Tables–QueryingData–User-DefinedFunctions–Oracle BigData.

Course learning outcomes:

- Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
- Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
- Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.

- Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Suggested books:

1. Data Mining and Business Analytics with R, by Johannes Ledolter; Publisher: Wiley (2013), ISBN-13: 978-1118447147;
2. An Introduction to Statistical Learning with Application in R, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani;Publisher: Springer (2013); ISBN-13: 978-1461471370;

Suggested reference books:

1.MichaelMinelli,Michehe Chambers,“Big Data,Big Analytics: Emerging Business IntelligenceandAnalyticTrendsforToday’sBusiness”,1stEdition,AmbigaDhiraj,WielyCIO Series,2013.
2.ArvindSathi,“BigDataAnalytics:DisruptiveTechnologiesforChangingtheGame”, 1stEdition,IBMCorporation,2012.
3.BillFranks,“TamingtheBigDataTidalWave:Finding Opportunities in Huge Data Streams withAdvancedAnalytics”,1stEdition,WileyandSASBusinessSeries,2012.
4.Tom White,“Hadoop:TheDefinitiveGuide”,3rdEdition,O’reilly,2012.

Online links for study & reference materials:

1. https://catalyst.library.jhu.edu/catalog/bib_6591386
2. https://catalyst.library.jhu.edu/catalog/bib_4637122

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Thread 4: Applications

Course Code : PEC- CS-A 501 **Course Name:** Image Processing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the need for image transforms different types of image transforms and their properties.
- To develop any image processing application.
- To understand the rapid advances in Machine vision.
- To learn different techniques employed for the enhancement of images.

Course Description:

This course will cover the fundamentals of image processing. We will provide a mathematical framework to describe and analyze images as two- and three-dimensional signals in the spatial, spatio-temporal, and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image/video enhancement, recovery, and compression – but you will also learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools. We will introduce and use a wide variety of such tools – from optimization toolboxes to statistical techniques.

Course Contents:

UNIT 1

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

UNIT 2

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT 3

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

UNIY 4

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

UNIT 5

Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding

Text books:

- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Reference books:

- Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105079/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-A601 **Course Name:** Digital Signal Processing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To develop a thorough understanding of the central elements of discrete time signal processing theory and the ability to apply this theory to real-world signal processing applications.
- Use z-transforms and discrete time Fourier transforms to analyze a digital system.
- Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
- Design and understand finite & infinite impulse response filters for various applications.

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.

Course Contents:

Unit 1

Discrete time signals: Sequences; representation of signals on orthogonal basis; Samplingand reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequencyAnalysis, Inverse Systems, Discrete Fourier Transform (DFT),Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit 2

Designof FIR Digital filters: Windowmethod,Park-McClellan's method.Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Lowpass, Bandpass, Bandstop and High pass filters.

Unit 3

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit 4

Introduction to multiratesignalprocessing, Application of DSP.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications

Text books:

- S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV.

Reference books:

- A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
- John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
- L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105055/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-A 602 **Course Name:** Cloud Computing

Course Credit Hour: 3 **Total Contact Hour**: 42hr

Course Objective:

- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their importance

Course Description: This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Business Process as a Service (BPaaS). IaaS topics start with a detailed study the evolution of infrastructure migration approaches from VMWare/Xen/KVM virtualization, to adaptive virtualization, and Cloud Computing / on-demand resources provisioning.

Course Contents:

Unit I

INTRODUCTION

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity inCloud – On-demand Provisioning.

Unit II

CLOUD ENABLING TECHNOLOGIES

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels ofVirtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices –Virtualization Support and Disaster Recovery.

Unit III

CLOUD ARCHITECTURE, SERVICES AND STORAGE

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public,

Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – CloudStorage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

Unit IV

RESOURCE MANAGEMENT AND SECURITY IN CLOUD

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods

Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

Unit V

CLOUD TECHNOLOGIES AND ADVANCEMENTS

Hadoop – MapReduce – Virtual Box –– Google App Engine – Programming Environment forGoogle App Engine –– Open Stack – Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.

Course Learning Outcomes (CLOs):

CO1: Understand the fundamental principles of distributed computing.

CO2: Understand how the distributed computing environments known as Grids can be built from lower-level services.

CO3: Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.

CO4: Analyze the performance of Cloud Computing.

CO5: Understand the concept of Cloud Security.

Text books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to theInternet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security,CRC Press, 2017.

3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.

5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud:

Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Reference books:

1. Barrie Sosinsky: "Cloud Computing Bible", Wiley-India, 2010
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms", Wiley, 2011
3. Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", Springer, 2012
4. Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
5. Tim Mather, Subra Kumara swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media, 2009.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-CS-A 701 **Course Name:** Human Computer interaction

Course Credit Hour: 4hr **Total Contact Hour:** 60hr

Course Objective:

- Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
- Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

- Write a brief summary indicating how this will be conducted specifying the key topics of the whole course.
- Write about 4 to 5 lines or till 7 lines, if some course description demands.

Course Contents:

Unit 1

Introduction: Importance of user Interface – definition, importance of 8 good design. Benefits ofgood design. A brief history of Screen design. The graphical user interface – popularity of graphics,theconceptofdirectmanipulation,graphicalsystem,Characteristics,Webuser– Interfacepopularity,characteristics-Principlesofuserinterface

Unit 2

Designprocess: Human interaction with computers, importance of 8 human characteristics human consideration,Humaninteractionspeeds,understandingbusinessjunctions.IIIScreenDesigning:Designgoals – Scre

Unit 3

ScreenDesigning: Designgoals–Screenplanningandpurpose,8organizingscreenelements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition –amount of information – focus and emphasis – presentation information simply and meaningfully – informationretrievalonweb–statisticalgraphics–Technologicalconsiderationininterfacedesign.

Unit 4

Windows: New and Navigation schemes selection of window, 8 selection of devices based andscreen based controls. Components – text and messages, Icons and increases – Multimedia, colors,usesproblems, choosingcolors

Unit 5

Softwaretools: Specificationmethods,interface–BuildingTools.8InteractionDevices–Keyboardandfunctionkeys–pointingdevices–speechrecognitiondigitizationandgeneration–image and video displays –drivers.

Course Learning Outcomes (CLOs):

Understand fundamental design and evaluation methodologies of human computer interaction. Demonstrate knowledge of human computer interaction design concepts and related methodologies.

Apply theories and concepts associated with effective work design to real-world application

Text books:

1. AlanDix,JanetFinlay,GregoryAbowd,RussellBealeHumanComputer Interaction,3rdEditionPrenticeHall,2004.
2. JonathanLazarJinjuanHeidiFeng,HarryHochheiser,ResearchMethodsinHumanComputerInteraction,Wiley,2010.
3. BenShneidermanandCatherinePlaisantDesigningtheUserInterface:StrategiesforEffectiveHuman-ComputerInteraction(5thEdition,pp.672,ISBN0-321-53735-1,March2009),Reading,MA:Addison-WesleyPublishingCo.

Reference books:

“Human-Computer Interaction” by Dix

“Designing the User Interface: Strategies for Effective Human-Computer Interaction” by Shneiderman

Online links for study & reference materials:

https://guides.lib.uw.edu/research/hcid/hcid-rec

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : PEC-CS-A 702 **Course Name:** ELECTRONIC DESIGN AUTOMATION
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

To describe both simple and complex RTL design scenarios using VHDL/verilog. It gives practical information on the issues in ASIC prototyping using FPGAs, design challenges and how to overcome practical issues and concerns.

Course Description :

With this course the students will able to understand the concept of simulation &sysnthesis of complex circuits using VHDL/VERILOG.

Course Contents :

Unit1

Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.

Unit 2

Design entry by Verilog/VHDL/FSM, Verilog AMS.

Unit 3

Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.

Unit 4

Design for performance, Low power VLSI design techniques. Design for testability.

Unit 5

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping

Unit 6

Case studies and Speed issues.

Course Learning Outcomes(CLOs) :

CO1: Describe Finite State Machines and comprehend concepts of clock related issues.

CO2: Model digital circuits using Verilog and understand the concepts of analog and mixed signal Systems design using Verilog AMS.

CO3: Outline the concepts of different design flows in VLSI.

CO4: Illustrate different low power latches and Flip-flops.

CO5: Explain the concepts of IP cores and Prototyping.

Text books :

- Richard S. Sandige, Modern Digital Design , MGH, International Editions,1990
- T. R. Padmanabhan and B. F.V.G. Bala Tripura Sundari, Design through Verilog HDL , WSE, IEEE Press, 2004.
- Zeidman, Bob. Designing with FPGAS and CPLDS . CRC Press, 2002.
- KiatSeng Yeo, Samir S. Rofail, Wang-Ling Goh, CMOS/Bi CMOS ULSI Low Voltage Low Power , Pearson Education Asia 1st Indian reprint, 2002.
- Doug Amos, Austin Lesea, Rene Richter, FPGA based prototyping methodology manual , Xilinx.

Reference books :

- Palnitkar, Samir. Verilog HDL: a guide to digital design and synthesis . Pearson Education India, 2003.
- Givone, Donald D. Digital principles and design . Palgrave Macmillan, 2003.
- Roth, Charles H. Digital systems design using VHDL . Wadsworth Publ. Co., 1998.

Online links for study & reference materials :

http://smdpc2sd.gov.in/downloads/IEP/IEP%208/24-02-18%20Rejender%20pratap.pdf

https://inst.eecs.berkeley.edu/~cs150/sp02/useful_files/Synthesis_Simulation_Design_Guide.pdf

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-A 703 **Course Name:** Computer Graphics

Course Credit Hour: 3 **Total Contact Hour**: 40hr

Course Objective:

 Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.

 Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

Basic principles and techniques for computer graphics on modern graphics hardware. Students will gain experience in interactive computer graphics using the OpenGL API. Students will gain experience using a graphics application programming interface (OpenGL) by completing several programming projects.

Course Contents:

Unit- I

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scandisplays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawingalgorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallelversionofthese algorithms.

Unit– II

Transformations: Basic transformation, Matrix representations and homogenous coordinates,Compositetransformations,Reflectionsandshearing.

Windowing and Clipping:Viewing pipeline, viewing transformations, 2-D Clipping algorithms-Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barskyalgorithm, Line clipping against non-rectangular clip windows; Polygon clipping – SutherlandHodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Textclipping.

Unit– III

Three Dimensional: 3-D geometric primitives, 3-D Object representation, 3-D Transformation,3-Dviewing,projections,3-D Clipping.

Unit– IV

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, IntroductoryconceptsofSpline, Bspline and Beziercurvesandsurfaces.Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A-buffermethod, Scan line method, basic illumination models– Ambient light, Diffuse reflection,Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation,Color consideration,Transparencyand Shadows.

Course Learning Outcomes (CLOs):

CLO1: Have a basic understanding of the core concepts of computer graphics.

CLO2: Be capable of using OpenGL to create interactive computer graphics.

CLO3: Understand a typical graphics pipeline.

CLO 4: Have made pictures with their computer.

Text books:

1.Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, Sixth Edition, Edward Angel, Dave Shreiner, Pearson Education, 2011. ISBN 0132545233.

Reference books:

1.Hughes, Van Dam, et al. Computer Graphics Principles and Practice 3e, Pearson, 2014

2. OpenGL Programming Guide, Addison-Wesley, 2004.

1. OpenGL Reference Manual, Addison-Wesley, 2004.

2. E. Angel, OpenGL: A Primer Addison-Wesley, 2004. P Shirley, Fundamentals of Computer Graphics, 2e, AK Peters, 2005

3. Hearn and Baker Computer Graphics with OpenGL, 3e, Prentice Hall, 2004.

4. Foley and Van Dam, Fundamentals of Interactive Computer Graphics

5. Moller and Haines, Real-time Rendering, AK Peters,

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

Civil Engineering

PREFACE

There has been a concern about quality of technical education in India although in terms of access and equity, India has done very well. AICTE is mandated for planned and coordinated development of Technical Education; regulate proper maintenance of norms & standards and expansion of technical Education with Quality. Accordingly, AICTE in its 49th meeting of the Council held on 14.3.2017 approved a package of measures for improving quality of technical education in the country. Revision of Curriculum, Mandatory Internship and Induction Program were amongst the few major quality initiatives taken by AICTE. AICTE, in consultation with MHRD constituted subject-wise Heads of the Committees with a respective team of academic experts along with industry expert to draft the model curriculum of UG engineering courses along with Induction Program for students. During the meetings held for developing model curriculum for undergraduate engineering courses, a concern was shared that in the present system, the first year syllabus is heavily loaded and it is of utmost importance that the students entering into the first year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a student to acclimatize to the new environment of a college and to create a bonding between the teacher and a student. An idea to introduce induction program in the curriculum to equip the students with communication skills, and get them acquainted with the culture of institution and human values was formalized. A student has to undergo this induction program after joining the institute and before the commencement of classes. Normal classes of the engineering program shall begin after the students have undergone a threeweeks induction program. The Induction program for students comprises of Physical activities; Learning an art form; Literature & Cinema; Social Awareness; Lectures &Visits; Universal Human Values; Familiarization to Department/Branch, College& Innovations. To sensitize on the need of induction program, one-day workshops for Principals/ Directors/ Promoters of Society/Trust/Institutions were held at Hyderabad, Bangalore, Mumbai, Kolkata and Delhi. Subsequently, five-day Teacher Training workshops for Student induction were also held at Hyderabad, Varanasi and Pune. Also, AICTE has made 6-8 weeks summer internships mandatory before completion of under graduation. This will equip the students with practical understanding and training about industry practices in a suitable industry or organization. A novel concept of Virtual Laboratories has also been introduced in the Model Curriculum. MHRD has successfully completed two phases of project under NPTEL, to develop Virtual Labs through a consortium headed by IIT Delhi. During these phases, more than 180 labs were developed, comprising of more than 1700 experiments, in different domains of engineering. These experiments are field tested through various nodal centres across the country. The Virtual Labs. essentially comprise of a user friendly graphical front. It would be a far enriching experience to use virtual labs and learn at one"s own pace and time.

A student can even learn the skills which are not part of the curriculum but required as professionals to take up new challenges. A chapter on „Virtual Laboratories: A new way of Learning" is a part of this Model Curriculum. It was also felt that students should get holistic education which has components of sports, physical activities, values and ethics. The respective Heads of the Committees & teams discussed the existing system prevalent in engineering colleges, industry requirements and market trends, employability, problem solving approach, need for life long learning and after due deliberations, the scheme and syllabus for various engineering disciplines have been formalized. Salient features of this model curriculum are enumerated below:

i. Induction program has been made a part of this Model Curriculum.
ii. Model Curriculum has been designed in such a way that it encourages innovation and research as total number of credits has been reduced and many new courses have been incorporated in consultation with industry experts.
iii. The revised Model Curriculum has been designed where the students can understand the industry requirements and have hands-on experience. The students will develop a problem solving approach and will be able to meet the challenges of future.
iv. It is also understood that different engineering disciplines should have some flexibility in being different. All engineering disciplines cannot be made to conform to a fixed structure. Though, AICTE has compiled a common first year scheme and syllabi for engineering disciplines, the concerned Institution/ University may adjust the scheme and courses as per the requirement of particular Institute and local needs. However, the total credit structure of 160 credits should not be disturbed. The institutions/ universities in India are requested to adopt this "Model Curriculum" for various undergraduate degree engineering disciplines.
v. Courses on Constitution of India, Environment Science/Engg. and Essence of India Traditional Knowledge have also been included in the Curriculum.
vi. A novel concept of Virtual laboratories has been introduced in the model curriculum.
vii. Curriculum on Entrepreneurship is included to support AICTE"s start-up policy.
viii. In some disciplines, courses have been mentioned in the scheme; it is left to the University/Institution to frame the detailed syllabus as per their need or can find the same in the AICTE model curriculum of some other disciplines in this booklet.
ix. AICTE will ensure the revision of the model curriculum on regular basis and this updation will certainly help students to achieve better employability; start-ups and other avenues for higher studies.

Course Structure & Credit Distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical(Lab)/week	0.5 credits 1 credit

B. Range of credits :

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honors' or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Course code and definition

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses

D. Credit distribution in the First year of Undergraduate Engineering program

	Lecture	Tutorial	Laboratory/Practical	Total credits
Chemistry-I	3	1	3	5.5
Physics	3	1	3	5.5
Mathematics-I	3	1	0	4
Mathematics –II	3	1	0	4
Programming for Problem Solving	3	0	4	5
English	2	0	2	3
Engineering Graphics	1	0	4	3
Workshop/ Practical	1	0	4	3
Basic Electrical Engineering	3	1	2	5
Environmental Studies	2	0	0	00

BASIC SCIENCE COURSES

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits
1	BSC 101	Mathematics – I	3:1:0	4
2	BSC 102	Physics	3:1:3	5.5
3	BSC 103	Mathematics – II	3:1:0	4
4	BSC 104	Chemistry-I	3:1:3	5.5
				19

ENGINEERING SCIENCE COURSES

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits
1	ESC 101	Programming for Problem Solving	3:0:4	5
2	ESC 102	Workshop/Manufacturing Practices	1:0:4	3
4	ESC 103	Engineering Graphics	1:0:4	3
5	ESC 104	Basic Electrical Engineering	3:1:2	5
		Total		16

HUMANITIES & SOCIAL SCIENCES COURSE

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits
1	HSMC 101	English	2:0:2	3

MANDATORY COURSE

Sr. No.	Course Code	Course Title	Credits
1	AECC01	Environmental Studies	00

Induction Program

Induction program (mandatory)	**2 weeks duration**
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

Bachelor of Technology-CE

FIRST SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					
			L	T	P	Internal Assessment CA	Internal Assessment TA	Internal Assessment Total	External Assessment	Total	Total Credits
1	BSC 101	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC104	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC 101	English	2	0	0	20	20	40	60	100	2
4	ESC101	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5	ESC103	Engineering Graphics	1	0	0	20	20	40	60	100	1
		Induction Program	-	-	-	-	-	-	-		0
PRACTICALS											
1	BSC 104P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC101P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	ESC103P	Engineering graphics Lab	0	0	4			40	60	100	2
4	HSMC101P	English Lab	0	0	2			40	60	100	1
Total											**20.5**

SECOND SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					
						Internal Assessment			External Assessment	Total	Total Credits
			L	T	P	CA	TA	Total			
1	BSC102	Physics	3	1	0	20	20	40	60	100	4
2	BSC 103	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC102	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC104	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	Environmental Studies	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC104P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1
Total											**17.5**

THIRD SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
ESC202	Basic Electronics	1	0	0	1	20	20	40	60	100
ESC203	Computer-aided Civil Engineering Drawing	1	0	0	1	20	20	40	60	100
ESC205	Engineering Mechanics	3	1	0	4	20	20	40	60	100
ESC212	Energy Science & Engineering	1	1	0	2	20	20	40	60	100
BSC225	Life Science	1	0	0	1	20	20	40	60	100
BSC201	Mathematics-III (Transform & Discrete Mathematics)	2	0	0	2	20	20	40	60	100
HSMC201	Humanities-I (Effective Technical Communication)	3	0	0	3	20	20	40	60	100
HSMC251	Introduction to Civil Engineering	2	0	0	2	20	20	40	60	100
	Generic Elective	3	-	-	3	20	20	40	60	100
	Online Course, NPTEL								100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
ESC202P	Basic Electronics	0	0	2	1	20	20	40	60	100
ESC203P	Computer-aided Civil Engineering Drawing	0	0	2	1	20	20	40	60	100
BSC225P	Life Science	0	0	2	1	20	20	40	60	100
Total		**17**	**2**	**6**	**22**					

FOURTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
ESC209	Mechanical Engineering	2	1	0	3	20	20	40	60	100
PCC-CE201	Instrumentation & Sensor Technologies for Civil Engineering Applications	1	1	0	2	20	20	40	60	100
PCC-CE202	Engineering Geology	1	0	0	1	20	20	40	60	100
PCC-CE203	Disaster Preparedness &Planning	1	1	0	2	20	20	40	60	100
PCC-CE204	Introduction to Fluid	2	0	0	2	20	20	40	60	100
PCC-CE205	Introduction to Solid Mechanics	2	0	0	2	20	20	40	60	100
PCC-CE206	Surveying & Geomatics	1	1	0	2	20	20	40	60	100
PCC-CE207	Materials, Testing & Evaluation	1	1	0	2	20	20	40	60	100
HSMC252	Civil Engineering -Societal & Global Impact	2	0	0	2	20	20	40	60	100
MC-CE207	Management I (Organizational Behavior)	3	0	0	0	20	20	40	60	100
	Generic Elective	3	-	-	3	20	20	40	60	100
	Online Course, NPTEL	-	-	-	-	-	-	-	100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
PCC-CE201P	Instrumentation & Sensor Technologies for Civil Engineering Applications	0	0	2	1	20	20	40	60	100
PCC-CE202P	Engineering Geology	0	0	2	1	20	20	40	60	100
PCC-CE204 P	Introduction to Fluid Mechanics	0	0	2	1	20	20	40	60	100
PCC-CE206P	Surveying & Geomatics	0	0	2	1	20	20	40	60	100
PCC-CE207P	Materials, Testing & Evaluation	0	0	2	1	20	20	40	60	100
	Total	**19**	**3**	**10**	**21**					

FIFTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PCC-CE301	Mechanics of Materials	3	0	0	3	20	20	40	60	100
PCC-CE302	Hydraulic Engineering	2	0	0	2	20	20	40	60	100
PCC-CE303	Structural Engineering	2	1	0	3	20	20	40	60	100
PCC-CE304	Geotechnical Engineering	2	0	0	2	20	20	40	60	100
PCC-CE305	Hydrology & Water Resources Engineering	2	2	0	4	20	20	40	60	100
PCC-CE306	Environmental Engineering	2	2	0	4	20	20	40	60	100
PCC-CE307	Transportation Engineering	2	0	0	2	20	20	40	60	100
HSMC255	Professional Practice, Law & Ethics	2	0	0	2	20	20	40	60	100
MC-1	Constitution of Constitution of India/ Essence of Indian Traditional Knowledge	-	-	-	0	20	20	40	60	100
	Generic Elective	3	-	-	3	20	20	40	60	100
	Online Course, NPTEL								100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
PCC-CE302P	Hydraulic Engineering	0	0	2	1	20	20	40	60	100
PCC-CE304P	Geotechnical Engineering	0	0	2	1	20	20	40	60	100
PCC-CE307P	Transportation Engineering	0	0	2	1	20	20	40	60	100
PCC-CE303P	Structural Engineering	0	0	2	1	20	20	40	60	100
Total		**20**	**5**	**8**	**29**					

SIXTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PCC-CE308	Construction Engineering &Management	2	1	0	3	20	20	40	60	100
PCC-CE309	Engineering Economics, Estimation & Costing	2	1	0	3	20	20	40	60	100
PEC-CEEL302	Elective I	3	0	0	3	20	20	40	60	100
PEC-CEEL304	Elective II	3	0	0	3	20	20	40	60	100
OEEL302	Open Elective-I (Humanities)	3	0	0	3	20	20	40	60	100
PEC-CEEL306	Elective-III	3	0	0	3	20	20	40	60	100
PEC-CEEL308	Elective-IV	3	0	0	3	20	20	40	60	100
	Generic Elective	3	0	0	3	20	20	40	60	100
	Online Course, NPTEL								100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
PCC-CE309P	Engineering Economics, Estimation & Costing	0	0	4	2	20	20	40	60	100
Total		**22**	**2**	**4**	**26**					

****The marks will be awarded on the basis of 06 weeks industrial training conducted after 4thsemester**

SEVENTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PEC-CEEL401	Elective V	3	0	0	3	20	20	40	60	100
PEC-CEEL403	Elective VI	3	0	0	3	20	20	40	60	100
OEC401	Open Elective-II Suggested (Metro Systems & Engineering)	3	0	0	3	20	20	40	60	100
	Generic Elective	3	0	0	3	20	20	40	60	100
	Online Course, NPTEL								100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
PROJ-CE401	Project-1 (Project work, seminar and internship in industry or at appropriate work place)	0	0	12	6	20	20	40	60	100
Total		**12**	**0**	**12**	**18**					

EIGHTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PECCEEL-402	Elective VII	3	0	0	3	20	20	40	60	100
PECCEEL-402	Elective VIII	2	0	0	2	20	20	40	60	100
OEC- 403	Open Elective-III	3	0	0	3	20	20	40	60	100
OEC- 404	Open Elective-IV	2	0	0	2	20	20	40	60	100
	Generic Elective	3	0	0	3	20	20	40	60	100
	Online Course, NPTEL								100	100
	General Proficiency	-	-	-	-	-	-	-	-	50
PRACTICALS										
PROJ-CS80	Project-2(Continued from VI Semester, Project work, seminar and internship in industry or at appropriate work place)	0	0	12	6	100	100	200	300	500
Total		**13**	**0**	**12**	**19**					

Professional Elective Courses

I	**Transportation Engineering** 1. Pavement Materials 2. Pavement Design 3. Public Transportation Systems 4. Traffic Engineering and Management 5. Urban Transportation Planning. 6. Geometric Design of Highways 7. Airport Planning and Design 8. Railway Engineering 9. Intelligent Transportation Systems 10. Highway Construction and Management 11. Port and Harbour Engineering 12. High Speed Rail Engineering 13. Transportation Economics 14. Infrastructure Planning and Design	II	**Construction Engineering & Management** 1. Construction Productivity 2. Building Construction Practice 3. Construction Project Planning &Systems 4. Construction Cost Analysis 5. Sustainable Construction Methods 6. Construction Engineering Materials. 7. Contracts Management 8. Construction Equipment& Automation 9. Repairs & Rehabilitation of Structures
III	**Environmental Engineering** 1. Ecological Engineering 2. Environmental Systems 3. Transport of Water and Wastewater 4. Environmental Laws and Policy 5. Physico-Chemical Processes for Water and Wastewater Treatment 6. Biological Processes for Contaminant Removal 7. Rural Water Supply and Onsite Sanitation Systems 8. Water and Air Quality Modeling 9. Solid and Hazardous Waste Management 10. Air and Noise Pollution and Control 11. Environmental Impact Assessment and Life Cycle Analyses 12. Sustainable Engineering & Technology	IV	**Hydraulics** 1. Design of hydraulic structures/Irrigation Engineering 2. Pipeline Engineering 3. Open Channel flow 4. River Engineering 5. Hydraulic modelling 6. Basics of computational hydraulics 7. Transients in closed conduits 8. Urban Hydrology and Hydraulics 9. Groundwater
V	**Hydrology & Water Resources Engineering** 1. Water Quality Engineering 2. Surface Hydrology 3. Environmental Fluid Mechanics 4. Water Resources Field Methods	VI	**Structural Engineering** 1. Reliability Analysis of Structures 2. Engineering Risk & Uncertainty 3. Decision and Risk Analysis 4. Engineering Materials for Sustainability 5. Concrete Materials 6. Wood Structures 7. Masonry Structures 8. Structural Analysis-I 9. Structural Analysis-II 10. Advanced Structural Analysis 11. Structural Analysis by Matrix Methods 12. Structural Mechanics 13. Reinforced Concrete 14. Concrete Technology 15. Design of Concrete Structures-I

			16. Design of Concrete Structures-II 17. Prestressed Concrete 18. Design of Steel Structures 19. Metal Structure Behaviour- I 20. Metal Structure Behaviour- II 21. Bridge Engineering 22. Industrial Structures 23. Design of Structural Systems 24. Structural Dynamics 25. Earthquake Engineering 26. Civil Engineering Design-I 27. Civil Engineering Design-II 28. Geographic Information Systems and Science 29. Modelling and Analysis of Uncertainty 30. Systems Engineering & Economics
VII	**Geotechnical Engineering** 1. Soil Mechanics-I 2. Soil Mechanics-II 3. Foundation Engineering 4. Geotechnical Design 5. Structural Geology 6. Offshore Engineering 7. Rock Mechanics 8. Environmental Geo-technology		

Open Elective Courses [OEC]

I	Soft Skills and Interpersonal Communication
II	ICT for Development
III	Human Resource Development and Organizational Behavior
IV	Cyber Law and Ethics
V	Introduction to Philosophical Thoughts
VI	Comparative Study of Literature
VII	Indian Music System
VIII	History of Science & Engineering
IX	Introduction to Art and Aesthetics
X	Economic Policies in India
XI	Metro Systems and Engineering

DETAILED 4-YEAR CURRICULUMCONTENTS

Undergraduate Degree in School Engineering &Technology

BRANCH/COURSE: CIVIL ENGINEERING

Semester I (First year] Branch/Course Civil Engineering

Course Code: BSC101 **Course Name:** Mathematics-I
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)
Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)
Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems
- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:
https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: BSC102 **Course Name:** Chemistry-I
Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers. Understand the relationship between biological properties of pairs of enantiomers or diastereomer.
  - Draw the E or Z isomer of a given alkene
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, "University chemistry", Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", McGraw- -ill International.
- C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry" (NPTEL).
- K. P. C. Volhardt and N. E. Schore, " Organic Chemistry: Structure and Function" Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC101 **Course Name:** English
Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)
Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication **(4 lectures)**
(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.
- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECS101 **Course Name:** Programming for Problem Solving
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays
Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 6: Recursion
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure
Structures, Defining structures and Array of Structures.

Unit 8: Pointers
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

(iv) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.

(v) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.

(vi) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

   R=1 c=1 sum=2

   R=1 c=2 sum=3

   R=2 c=1 sum =3

   R=2 c=2 sum=4

6. Write a program to print the following pattern
7. Write a program to print the square and cube of any given number.

```
*****    *         1
****     **        12
****     ***       123
****     ****      1234
         *****     12345
```

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
   - Find the length of the string.
   - Concatenate two strings
   - Compare two given strings
   - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers.
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.

10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab
Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr'sMethod.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodiumhydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

Semester II (Second year] Branch/Course Civil Engineering

Course Code: BSC102 **Course Name:** Physics
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)
Introduction to Quantum mechanics
Wave nature of particles
Time independent and time dependent Schrodinger equation for wave function
Born interpretation
Probability current
Expectation values
Free particle wavefunction and wave packets
Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)
Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)
Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator
Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)
Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)
Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars
Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands
Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

Course Code: BSC103 **Course Name:** Mathematics II
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:
Unit 1: Multivariable Calculus (Integration): (10 lectures)
Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)
Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)
Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.
- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC102 **Course Name:** Workshop/Manufacturing Practices
Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1

Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel. Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III

Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.
Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.
Gas & Spot Welding To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

Module V

Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, “Manufacturing Technology – I” Pearson Education, 2008.
- Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
- Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ESC104 **Course Name:** Basic Electrical Engineering
Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

Unit 1: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, “ Basic Electrical Engineering”, Tata McGraw Hill.
- D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill.

Reference books:

- L. S. Bobrow, “ Fundamentals of Electrical Engineering”, Oxford University Press.
- E. Hughes, “Electrical and Electronics Technology”, Pearson.
- V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: AECCI **Course Name:** Environmental Science
Course Credit Hour: 2hr **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem Physical (energy flow), Biological (food chains, food web, ecological succession) and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

Unit 5: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

Unit 6: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):

The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 ¬
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 ¬
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 ¬
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:
https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Lab Code: BSC101P **Lab Name:** Physics Lab
Course Credit Hour: 1.5hr **Total Contact Hour:** 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC102P **Lab Name:** Workshop/Manufacturing Practice
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: ESC104P **Lab Name:** Electrical Engineering Lab

Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

Semester III (Second year] Branch/Course Civil Engineering

SC202	**Basic Electronics**	**1L:0T:2P**	**2 credits**

Course Objective-

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Civil Engineering applications. Lab should be taken concurrently. This course emphasizes more on the laboratory/practical use of the knowledge gained from the course lectures.

What Will I Learn?

a) Know broadly the concepts and functionalities of the electronic devices, tools and instruments

b) Understand use, general specifications and deployabilities of the electronic devices, and assemblies

c) Confidence in handling and usage of electronic devices, tools and instruments in engineering applicationsProposed Syllabus (All modules to provide only broad overview)

Module1: Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Module 2: Transistor Characteristics covering, Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs, Introduction to CMOS circuits;

Module 3: Transistor Amplifiers and Oscillators covering, Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, Distortion, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Module 4: Operational Amplifiers and Applications covering, Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground;

Practicals:

Module 1: Laboratory Sessions covering, Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed CircuitBoards (PCBs); Identification, Specifications, Testing of Active

Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;

Module 2: Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; (CRO);

Module 3: Experimental Verification of PN Junction Diode Characteristics in A) Forward Bias B) Reverse Bias, Zener Diode Characteristics and Zener Diode as Voltage Regulator, Input and Output Characteristics of BJT in Common Emitter (CE) Configuration, Drain and Transfer Characteristics of JFET in Common Source (CS) Configuration;

Module 4: Study of Half Wave and Full Wave Rectification, Regulation with Filters, Gain and Bandwidth ofBJT Common Emitter (CE) Amplifier, Gain and Bandwidth of JFET Common Source (CS) Amplifier, Gain and Bandwidth of BJT Current Series and Voltage Series Feedback Amplifiers, Oscillation Frequency of BJT based RC Phase Shift, Hartley and Colpitts Oscillators;

Module 5: Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Op-Amp Applications – Differentiator and Integrator, Square Wave and Triangular Wave Generation, Applications of555 Timer – Astable and Monostable Multivibrators;

Module 6: Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop ICs; Serial-In-Serial-Out and Serial-In-Parallel-Out Shift operations using 4-bit/8-bit Shift Register ICs; Functionality of Up-Down / Decade Counter ICs; (15 Sessions)

Text/Reference Books:

1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.
2. Santiram Kal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India.
3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education,
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH
5. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson

Course Code: BSC109 **Course Name: Biology (Biology for Engineers)**
Course Credit Hour: 2hr **Total Contact Hour: 21**

Course Objectives
Gain vivid knowledge in the fundamentals and uses of biology, human system and plant system.

Course Outcomes
After completing this course, the student will be able to:
1. Apply biological engineering principles, procedures needed to solve real-world problems.
2. Understand the fundamentals of living things, their classification, cell structure and biochemical constituents.
3. Apply the concept of plant, animal and microbial systems and growth in real life situations.
4. Comprehend genetics and the immune system.
5. Know the cause, symptoms, diagnosis and treatment of common diseases.
6. Apply basic knowledge of the applications of biological systems in relevant industries.

Module 1. (2 hours)- Introduction
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification
Purpose: To convey that classification per se is not what biology is all about. The underlying criterion, suchas morphological, biochemical or ecological be highlighted.
Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion
– aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3. (4 hours)-Genetics
Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"
Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. (4 hours)-Biomolecules
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine
Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose: How to analyses biological processes at the reductionistic level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic andexergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energycurrency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) andsynthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions.Concept of Energy charge

Module 9. (3 hours)- Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S.A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman andCompany.
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company,Distributed by Satish Kumar Jain for CBS Publisher.
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Course Code: ESC203
Course Credit Hour-2hr

Course Name: Computer-aided Civil Engineering Drawing
Total Contact Hour- 30

Course Objectives:

The students will be able to

a) Develop Parametric design and the conventions of formal engineering drawing

b) Produce and interpret 2D & 3D drawings

c) Communicate a design idea/concept graphically/ visually

Course Description:

- Examine a design critically and with understanding of CAD - The student learn to interpret drawings,and to produce designs using a combination of 2D and 3D software.
- Get a Detailed study of an engineering artifact

Module 1:INTRODUCTION; Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.(2)

Module 2:SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards (2)

Module 3: MASONRY BONDS:English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall (1)

Module 4: BUILDING DRAWING: Terms, Elements of planning building drawing, Methods of makingline drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity (7)

Module 5:PICTORIAL VIEW: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM)

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows. 09
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars,finishing and other details and writing out a description of the Facility in about 500 -700 words.
3. RCC framed structures 09
4. Reinforcement drawings for typical slabs, beams, columns and spread footings. 09
5. Industrial buildings - North light roof structures - Trusses 06
6. Perspective view of one and two storey buildings 06

Text/Reference Books:

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata-McGraw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt.Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building,Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons,

Course Learning Outcomes(CLOs):

The course should enable the students to

i) To develop graphical skills for communicating concepts, ideas and designs of engineering products graphically/ visually as well as understand another person's designs,

ii) and to get exposure to national standards relating to technical drawings using Computer AidedDesign and Drafting practice

iii) Develop Parametric design and the conventions of formal engineering drawing

iv) Produce and interpret 2D & 3D drawings

v) Examine a design critically and with understanding of CAD - The student learn to interpretdrawings, and to produce designs using a combination of 2D and 3D software.

vi) Do a detailed study of an engineering artefact

vii) Develop drawings for conventional structures using practical norms.

Course Code: ESC205 **Course Name: Engineering Mechanics**
Course Credit Hour: 3hr **Total Contact Hour: 21**

Course Objectives
The objectives of this course is to impart knowledge of

1. Resolution of forces, equilibrium of force systems consisting of static loads
2. Obtaining centroids and moments of inertia for various regular and irregular areas.
3. Various forces in the axial force members, and to analyse the trusses using various methods,
4. Concept of friction for single and connected bodies.
5. Concept of friction for single and connected bodies.
6. Work energy principles and impulse momentum theory and applications to problem solving

Course Description:
After completing this course, the student will be able to:

1. Apply the fundamental concepts of forces, equilibrium conditions for static loads.
2. Determine the centroid and moment of inertia for various sections.
3. Analyse forces in members of a truss using method of joints and method of sections, analyse friction for single and connected bodies.
4. Apply the basic concepts of dynamics, their behavior, analysis and motion bodies.
5. Solve problems involving work energy principles and impulse momentum theory.

Proposed Syllabus

Module 1*: Introduction to Engineering Mechanics covering,* Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Module 2*: Friction covering,* Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3*: Basic Structural Analysis covering,* Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4*: Centroid and Centre of Gravity covering,* Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Module 5*: Virtual Work and Energy Method-* Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Module 6*: Review of particle dynamics-* Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

Module 7:*Introduction to Kinetics of Rigid Bodies covering,* Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Module 8: *Mechanical Vibrations covering,* Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials *from the above modules covering*, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Text/Reference Books:

i) Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall

ii) F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

iii) R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

iv) Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press

v) Shanes and Rao (2006), Engineering Mechanics, Pearson Education,

vi) Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education

vii) Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics

viii) Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications

ix) Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.

x) Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Course Learning Outcome(CLOs)-

- Use scalar and vector analytical techniques for analysing forces in statically determinate structures
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
- Apply basic knowledge of maths and physics to solve real-world problems
- Understand measurement error, and propagation of error in processed data
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
- Understand basic dynamics concepts – force, momentum, work and energy;
- Understand and be able to apply Newton's laws of motion;
- Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution;
- Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
- Learn to solve dynamics problems. Appraise given information and determine which concepts apply,and choose an appropriate solution strategy; and
- Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

ESC212	Energy Science & Engineering	1L:1T:0P	2 credits

The objective of this Course is to provide *an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources such as solar, biomass (conversions), wind power, waves and tidal, geothermal, ocean thermal, hydro and nuclear. Energy conservation methods will be emphasized* from Civil Engineering perspective. The knowledge acquired lays a good foundation for design of various civil engineering systems/ projects dealing with these energy generation paradigms in an efficient manner.

Proposed Syllabus

Module 1: *Introduction to Energy Science:* Scientific principles and historical interpretation to *place ener*gy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment

Module 2: *Energy Sources:* Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries)

Module 3: *Energy & Environment:* Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy

Module 4: *Civil Engineering Projects connected with the Energy Sources:* Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems

Module 5: *Engineering for Energy conservation:* Concept of Green Building and Green Architecture;Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); *LEED ratings;* Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Text/Reference Books:

i) Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
ii) Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability:
Power for a Sustainable Future. Oxford University Press
iii) Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living, Gaiam
iv) Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
v) Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy andthe Environment, 2nd Edition, John Wiley
vi) UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment
vii) E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company.
viii) Related papers published in international journals

Upon successful completion of the course, the students will be able to:

- List and generally explain the main sources of energy and their primary applications nationally and internationally
- Have basic understanding of the energy sources and scientific concepts/principles behind them
- Understand effect of using these sources on the environment and climate
- Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
- List and describe the primary renewable energy resources and technologies.
- To quantify energy demands and make comparisons among energy uses, resources, and technologies.
- Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
- Understand the Engineering involved in projects utilising these sources

Course Code: BSC203 **Course Name: Life Science**
Course Credit Hour-2hr **Total Contact Hour- 30**

Module 1A: *Plant Physiology* covering, Transpiration; Mineral nutrition *(3 Lectures)*

Module 1B: *Ecology* covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; *(3 Lectures)*

Module 2A: *Population Dynamics* covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity; *(3 Lectures)*

Module 2B: *Environmental Management* covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant); *(3 Lectures)*

Module 3A: *Molecular Genetics* covering, Structures of DNA and RNA; Concept of Gene, Gene regulation, e.g., Operon concept; *(3 Lectures)*

Module 3B: *Biotechnology* covering, Basic concepts: Totipotency and Cell manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health; Recombinant DNA Technology- Techniques and applications; *(3 Lectures)*

Module 4A: *Biostatistics* covering, Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor) *(4 Lectures)*

Module 5 : *Laboratory & Fieldwork Sessions* covering, Comparison of stomatal index in different plants; Study of mineral crystals in plants; Determination of diversity indices in plant communities; To construct ecological pyramids of population sizes in an ecosystem; Determination of Importance Value Index of a species in a plant community; Seminar (with PPTs) on EIA of a Mega-Project (e.g., Airport, Thermal/Nuclear Power Plant/ Oil spill scenario); Preparation and extraction of genomic DNA and determination of yield by UV absorbance; Isolation of Plasmid DNA and its separation by Gel Electrophoresis; Data analysis using Bio-statistical tools; *(15 Sessions)*

Text/Reference Books:

i) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
ii) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
iii) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
iv) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
v) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. BrownPublishers

BSC201	Mathematics-III (Transform & Discrete Mathematics)	2L:1T:0P	2 credits

Transform Calculus

Module 8a: ***Transform Calculus*** **-1** (Prerequisite 2c, 5b-d, 6b) (10 hours)

Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials;

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Module 8b:***Transform Calculus*****-2** (10 hours)

Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.

Textbooks/References:

i) Erwin Kreyszig, Advanced Engineering Mathematics, 9^{th} Edition, John Wiley & Sons, 2006.
ii) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
iii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
iv) Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.

Discrete MathematicsModule 9a:***Sets, relations and functions*****:** (8 hours)

Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses.

Module 9b: ***Propositional Logic:*** (6 hours)

Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory.

Module 9c:***Partially ordered sets:*** (6 hours)

Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. Boolean and pseudo Boolean lattices.

Module 9d:***Algebraic Structures:*** (6 hours)

Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Error correcting code. Algebraic structures with two binary operations-ring, integral domain, and field. Boolean algebra and boolean ring (Definitions and simple examples only).

Module 9e: ***Introduction to Counting:***(6 hours)

Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions.

Module 9f: ***Introduction to Graphs:*** (8 hours)

Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Textbooks/References:

i) C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
ii) R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
iii) R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
iv) K. H. Rosen, Discrete Mathematics and its Applications, 6th Ed., Tata McGraw-Hill, 2007.
v) J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Ed., Jones and Bartlett, 2010.
vi) N. Deo, Graph Theory, Prentice Hall of India, 1974.
vii) S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
viii) J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.

Semester IV (Second year] Branch/Course Civil Engineering

ESC209	**Mechanical Engineering**	**2L:2T:0P**	**3 credits**

Module 1: Basic Concepts- Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady-Flow

Module 3: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energy balance.

Module 4: Properties Of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

Module 5: Power Cycles- Vapour and combined power cycles, including the Carnot vapour cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, an overview of reciprocating engines, air standard assumptions,gasoline engine Otto cycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles

Module 6: Ideal and Real Gases and Thermodynamic Relations- Gas mixtures – properties ideal and real gases. Equation of state, Avogadro's Law, Vander Waal's equation of state, Compressibility factor, compressibility chart. Dalton's law of partial pressure. Exact differentials, T-D relations, Maxwell's relations. Clausius Clapeyron equations, Joule – Thomson coefficient.

Module 7: Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor-compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/Reference Books:

i) Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi.
ii) Cengel, Thermodynamics – An Engineering Approach *Tata McGraw Hill, New* Delhi.
iii) Sonntag, R. E., Borgnakke, C., & Wylen, G. J. V. Fundamentals of thermodynamics: Wiley.
iv) Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals of
v) Jones, J. B., & Dugan, R. E. Engineering thermodynamics: Prentice Hall.
vi) Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers, McGraw-Hill.

Upon successful completion of the course, student will have:

- Ability to apply mathematics, science, and engineering
- Ability to design and conduct experiments, as well as to analyze and interpret data
- Ability to identify, formulate, and solve engineering problems
- Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations.
- Ability to comprehend the thermodynamics and their corresponding processes that influence the behaviour and response of structural components
- Ability to apply principles of engineering, basic science, and mathematics (including multivariatecalculus and differential equations) and thermodynamics to model,
- Analyze, design, and realize physical systems, components, or processes

PCC-CE201	**Instrumentation & Sensor Technologiesfor Civil Engineering Applications**	**1L:1T:2P**	**3 credits**

The objective of this Course is to understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, life time analysis and decisionmaking. This course introduces theoretical and practical principles of design of sensor systems. Topics include: transducer characteristics for acoustic, current, temperature, pressure, electric, magnetic, gravity, salinity, concentration of contaminants, velocity, heat flow, and optical devices; limitations on these devices imposed by building/structure/pavement environments; signal conditioning and recording; noise, sensitivity, and sampling limitations; and standards. Lectures will cover the principles of state-of-the-art systems being used in physical infrastructure/bridges/buildings/pavements, etc. For lab work, the course will allow students to prepare, deploy and analyze observations from standard instruments. Laboratory experiments shall be used on application of concepts introduced in the lectures. Providing principle knowledge, practical training and measurement best practice for a range of temperature, pressure, electrical, velocity, acceleration and vibration systems

Proposed Syllabus

Module 1*: Fundamentals of Measurement, Sensing and Instrumentation covering* definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

Module 2*: Sensor Installation and Operation covering to:* i) Predict the response of sensors to various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

Module 3*: Data Analysis and Interpretation covering* a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

Module 4*: Frequency Domain Signal Processing and Analysis covering* Explain the need for frequency domain analysis and its principles; Draw conclusions about physical processes based on analysis of sensor data; Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution

Tutorials *from the above modules* demonstrating clearly the understanding and use for the sensors and instruments used for the problems posed and inferences drawn from the measurement and observations made along with evaluation report

Practical :

- i) Instrumentation of typical civil engineering members/structures/structural elements
- ii) Use of different sensors, strain gauges, inclinometers,
- iii) Performance characteristics
- iv) Errors during the measurement process
- v) Calibration of measuring sensors and instruments
- vi) Measurement, noise and signal processing
- vii) Analog Signal processing
- viii) Digital Signal Processing
- ix) Demonstration & use of sensor technologies

Text/Reference Books:

- i) Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
- ii) David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
- iii) S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
- iv) Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer

What will I learn?

- Understand the principles of operation and characteristics of instrumentation and integrated sensor systems
- Understand right use of sensors and instruments for differing applications along with limitations
- Recognize and apply measurement best practice and identify ways to improve measurement and evaluation
- Troubleshoot and solve problems in instrumentation and measurement systems Toinstill and encourage a questioning culture

Outcomes:

- To analyze the errors during measurements
- To specify the requirements in the calibration of sensors and instruments To describethe noise added during measurements and transmission
- To describe the measurement of electrical variables
- To describe the requirements during the transmission of measured signals To construct Instrumentation/Computer Networks
- To suggest proper sensor technologies for specific applications To design andset up measurement systems and do the studies

PCC-CE202	Engineering Geology	1L:0T:2P	2 credits

The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, and liquefaction.

Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation. Engineering geologists are applied geoscientists with an awareness of engineering principles and practice—they are not engineers.

Proposed Syllabus:

Module 1: Introduction-Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary & secondaryminerals.

Module 2: Petrology-Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock.. Field Classification chart. Structures. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Module3: Physical Geology- Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module 4:Strength Behavior of Rocks- Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Module 5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Case Study on Elevation and Subsidence in Himalayan region in India. Seismic Zone in India.

Module 6: Rock masses as construction material: Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Core logging .Rock Quality Designation. Rock mass description.

Module 7: Geology of dam and reservoir site- Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Module 8: Rock Mechanics- Sub surface 9nvestigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and sheer strength of rocks, Bearing capacity of rocks.

Practicals:

i) Study of physical properties of minerals.
ii) Study of different group of minerals.
iii) Study of Crystal and Crystal system.
iv) Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet, Galena, Gypsum.
v) Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite,Basalt and its varieties, Trachyte.
vi) Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales and its varieties.
vii) Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties. Quartzite, Phyllite.
viii) Study of topographical features from Geological maps. Identification of symbols in maps.

Text/Reference Books:

i) Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria & Sons

ii) Text Book of Engineering Geology, N. Chenna Kesavulu, 2nd Edition (2009), Macmillan Publishers India.

iii) Geology for Geotechnical Engineers, J.C.Harvey, Cambridge University Press (1982).

What will I learn?

Students will be able to:

- Use suitable software to examine geology, soil, geologic hazard, and NEHRP data to characterize a geologic site.
- Calculate the bulk properties of rocks and unconsolidated sediments such as density,void ratio, water contents, and unit weights.
- Evaluate rock-mass quality and perform a kinematic analysis.
- Apply the factor of safety equation to solve planar rock slide and toppling problems. Perform a grain-size analysis, determine plastic and liquid limits, and classify soils using the Unified Soil Classification System.
- Calculate soil consolidation magnitudes and rates under induced stress conditions. Determine soil strength parameters from in situ tests.
- Apply the method of slices and factor of safety equation to solve rotational slideproblems.

Outcomes:

Students will understand:

1. Site characterization and how to collect, analyze, and report geologic data using standards in engineering practice
2. The fundamentals of the engineering properties of Earth materials and fluids.
3. Rock mass characterization and the mechanics of planar rock slides and topples.
4. Soil characterization and the Unified Soil Classification System.
5. The mechanics of soils and fluids and their influence on settlement, liquefaction, and soilslope stability.

PCC-CE203	Disaster Preparedness & Planning Management	1L:1T:0P	2 credits

The overall aim of this course is to provide broad understanding about the basic concepts of Disaster Management with preparedness as a Civil Engineer. Further, the course introduces the various natural hazards that can pose risk to property, lives, and livestock, etc. And understanding of the social responsibility as an engineer towards preparedness as well as mitigating the damages.

The objectives of the course are i) To Understand basic concepts in Disaster Management ii) To Understand Definitions and Terminologies used in Disaster Management iii) To Understand Types and Categories of Disasters iv). To Understand the Challenges posed by Disasters vi) To understand Impacts of Disasters Key Skills

Proposed Syllabus

Module 1: Introduction - Concepts and definitions: disaster, hazard, vulnerability, risks-severity, frequency and details, capacity, impact, prevention, mitigation).

Module 2:Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module 3:Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module 4: Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module 5: Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/Reference Books:

i) http://ndma.gov.in/ (Home page of National Disaster Management Authority)
ii) http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
iii) Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
iv) Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
v) Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
vi) Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003

vii) Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IAS

Outcomes:

The student will develop competencies in

- the application of Disaster Concepts to Management
- Analyzing Relationship between Development and Disasters.
- Ability to understand Categories of Disasters and
- realization of the responsibilities to society

PCC-CE204	Introduction to Fluid Mechanics	2L:0T:2P	3 credits

The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineering problems. A training to analyse engineering problems involving fluids – such as those dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimed to prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in later semesters.

Module 1: Basic Concepts and Definitions – Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Module 2: Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floating bodies.

Module 3: Fluid Kinematics- Classification of fluid flow : steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal and real fluid flow; one, two and three dimensional flows; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three - dimensional continuity equations in Cartesian coordinates

Module 4: Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow
– Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber *Number and Euler Number; Buckingham's* π-Theorem.

Lab Experiments

i) Measurement of viscosity
ii) Study of Pressure Measuring Devices
iii) Stability of Floating Body
iv) Hydrostatics Force on Flat Surfaces/Curved Surfaces
v) Verification of Bernoulli's Theorem
vi) Venturimeter
vii) Orifice meter
viii) Impacts of jets
ix) Flow Visualisation -Ideal Flow
x) Length of establishment of flow
xi) Velocity distribution in pipes
xii) Laminar Flow

Text/Reference Books:

i. **F**luid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
ii. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
iii. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
iv. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

At the end of the course, the student will be able to:

- Understand the broad principles of fluid statics, kinematics and dynamics
- Understand definitions of the basic terms used in fluid mechanics
- Understand classifications of fluid flow
- Be able to apply the continuity, momentum and energy principles Be able to apply dimensional analysis

PCC-CE205	Introduction to Solid Mechanics	1L:0T:2P	2 credits

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behaviour is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analytical mechanics.

Proposed Syllabus

Module1: *Simple Stresses and Strains-* Concept of stress and strain, St. Venant's principle, stress and strain diagram,Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elasticmoduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience– Gradual, sudden, impact and shock loadings – simple applications.

Module 2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module 3: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module 4: *Flexural Stresses-Theory of simple bending* – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Module 5: *Shear Stresses- Derivation of formula* – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Module 6: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinantbeams.

Module 7: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Module 8: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

List of Experiments:

i) Tension test
ii) Bending tests on simply supported beam and Cantilever beam.
iii) Compression test on concrete
iv) Impact test
v) Shear test
vi) Investigation of Hook's law that is the proportional relation between force and stretching in elastic deformation,
vii) Determination of torsion and deflection,
viii) Measurement of forces on supports in statically determinate beam,
ix) Determination of shear forces in beams,
x) Determination of bending moments in beams,
xi) Measurement of deflections in statically determinate beam,
xii) Measurement of strain in a bar
xiii) Bend test steel bar;
xiv) Yield/tensile strength of steel bar;

Text/Reference Books:

i) Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
ii) Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
iii) Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
iv) Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
v) Laboratory Manual of Testing Materials - William Kendrick Hall
vi) Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf – TMH 2002.
vii) Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.

Outcomes:

On completion of the course, the student will be able to:

i) Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components;
ii) Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energy methods;
iii) Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thin wall beams;and
iv) Calculate the deflection at any point on a beam subjected to a combination of loads; solve forstresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thin walled members;

PCC-CE206	Surveying and Geomatics	1L:1T:2P	3 credits

Course Objectives

With the successful completion of the course, the student should have the capability to:

i) describe the function of surveying in civil engineering construction,
ii) Work with survey observations, and perform calculations,
iii) Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
iv) Be familiar with the principals of recording accurate, orderly, complete, and logical field notes from surveying operations, whether recorded manually or with automatic data collection methods,
v) Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
vi) Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and check levelling measurements,
vii) Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments. Be able to identifyhazardous environments and take measures to insure one's personal and team safety,
viii) Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSS instruments,
ix) Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for a closed traverse,
x) Perform traverse calculations; determine latitudes, departures, and coordinates of control points andbalancing errors in a traverse. Use appropriate software for calculations and mapping,
xi) Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
xii) Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
xiii) Calculate, design and layout horizontal and vertical curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Proposed Syllabus:

Module 1: *Introduction to Surveying (8 hours):* Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas and volumes.

*Triangulation and Trilateration (6 Hours)***:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices
- instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

Module 2: Curves (6 hours) Elements of simple and compound curves – Method of setting out– Elements ofReverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Module 3: *Modern Field Survey Systems (8 Hours)*: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations.

Module 4: *Photogrammetry Surveying (8 Hours)*: Introduction, Basic concepts, perspective geometryof aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, map substitutes.

Module 5: *Remote Sensing (9 Hours)*: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing.

Text/Reference Books:

i) Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GISand Remote Sensing, Pearson India, 2006.

ii) Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011

iii) Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010

iv) Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited,2002.

v) Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.

vi) Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Outcomes:

The course will enable the students to:

- Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities
- Translate the knowledge gained for the implementation of Civil infrastructure facilities
- Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetry and Remote Sensing.

PCC-CE207	Materials, Testing & Evaluation	1L:1T:2P	3 credits

The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, aswell as practical application of mechanical characteristics.

- Make measurements of behavior of various materials used in Civil Engineering.
- Provide physical observations to complement concepts learnt
- Introduce experimental procedures and common measurement instruments, equipment, devices.
- Exposure to a variety of established material testing procedures and techniques
- Different methods of evaluation and inferences drawn from observations

The course reviews also the current testing technology and examines force applications systems, force measurement, strain measurement, important instrument considerations, equipment for environmental testing, and computers applications for materials testing provide an introductory treatment of *basic skills in material engineering towards (i) selecting material for the design, and (ii) evaluating the mechanical and structural properties of material, as well as the knowledge necessary for a civil engineer.* The knowledge acquired lays a good analysis and design of various civil engineering structures/systems in a reliable manner.

What will I learn?

- Different materials used in civil engineering applications
- Planning an experimental program, selecting the test configuration, selecting the test specimens and collecting raw data
- Documenting the experimental program including the test procedures, collected data, method of interpretation and final results
- Operating the laboratory equipment including the electronic instrumentation, the test apparatus and the data collection system
- Measuring physical properties of common structural and geotechnical construction materials
- Interpreting the laboratory data including conversion of the measurements into engineering values and derivation of material properties (strength and stiffness) from the engineering values
- Observing various modes of failure in compression, tension, and shear
- Observing various types of material behavior under similar loading conditions

Proposed Syllabus

Module 1: *Introduction to Engineering Materials covering,* Cements, M-Sand, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete) Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates and adhesives, Graphene, Carbon composites and other engineering materials including properties and uses of these

Module 2: *Introduction to Material Testing covering,* What is the “Material Engineering”?; Mechanical behavior and mechanical characteristics; Elasticity – principle and characteristics; Plastic deformation of metals; Tensile test – standards for different material (brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test; strength of ceramic; Internal friction, creep – fundaments and characteristics; Brittle fracture of steel – temperature transition approach; Background of fracture mechanics; Discussion of fracture toughness testing – different materials; concept offatigue of materials; Structural integrity assessment procedure and fracture mechanics

Module 3: *Standard Testing & Evaluation Procedures covering,* Laboratory for mechanical testing; Discussion about mechanical testing; Naming systems for various irons, steels and nonferrous metals; Discussion about elastic deformation; Plastic deformation; Impact test and transition temperatures; Fracture mechanics – background; Fracture toughness – different materials; Fatigue of material; Creep.

Tutorials *from the above modules covering*, understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanationof mechanical behavior of these materials.

Practicals:

- i) Gradation of coarse and fine aggregates
- ii) Different corresponding tests and need/application of these tests in design and quality control
- iii) Tensile Strength of materials & concrete composites
- iv) Compressive strength test on aggregates
- v) Tension I - Elastic Behaviour of metals & materials
- vi) Tension II - Failure of Common Materials
- vii) Direct Shear - Frictional Behaviour
- viii) Concrete I - Early Age Properties
- ix) Concrete II - Compression and Indirect Tension
- x) Compression – Directionality
- xi) Soil Classification
- xii) Consolidation and Strength Tests
- xiii) Tension III - Heat Treatment
- xiv) Torsion test
- xv) Hardness tests (Brinnel's and Rockwell)
- xvi) Tests on closely coiled and open coiled springs
- xvii) Theories of Failure and Corroboration with Experiments
- xviii) Tests on unmodified bitumen and modified binders with polymers
- xix) Bituminous Mix Design and Tests on bituminous mixes - Marshall method
- xx) Concrete Mix Design as per BIS

Text/Reference Books:

- i) Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann
- ii) Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand& Bros, Fifth Edition
- iii) Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materialsused for Civil Engineering applications
- iv) Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
- v) E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
- vi) American Society for Testing and Materials (ASTM), *Annual Book of ASTM Standards* (post 2000)
- vii) Related papers published in international journals

Measurable Outcomes:

One should be able to:

- Calibrate electronic sensors
- Operate a data acquisition system
- Operate various types of testing machines
- Configure a testing machine to measure tension or compression behavior
- Compute engineering values (e.g. stress or strain) from laboratory measures
- Analyze a stress versus strain curve for modulus, yield strength and other related attributes
- Identify modes of failure
- Write a technical laboratory report

HSMC252	Civil Engineering – Societal & Global Impact	2L:0T:0P	2 credits

The course is designed to provide a better understanding of the impact which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realise the impact which this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial.

The course covers:

- Awareness of the importance of Civil Engineering and the impact it has on the Society and at global levels
- Awareness of the impact of Civil Engineering for the various specific fields of human endeavour
- Need to think innovatively to ensure Sustainability

Module 1: Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;

Module 2: Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Module 3: Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

Module 4: Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

Module 5: Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

Module 6: Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment (projects, facilities management),

Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

ORGANISATION OF COURSE (2-0-0)

S. No.	Module	No of Lectures	Details
1	Introduction	3	
2	Understanding the Importance of Civil Engineering	3	
3	Infrastructure	8	
4	Environment	7	
5	Built Environment	5	
6	Civil Engineering Projects	4	
	TOTAL	**30**	

Text/Referenc Books:

i) *Ž iga* Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht

ii) Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition

iii) NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.

iv) Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

v) Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options

vi) http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx

vii) Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014

viii) Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130

ix) Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.

x) Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE EngineeringSustainability 163. June Issue ES2 p61-63

xi) Brown R R., Ashley R M., Farrelly M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research**.** Water Resources Management. Vol. 23, No.4. European Water Resources Association (EWRA) ISSN 0920-4741.

xii) Brugnach M., Dewulf A., Pahl-Wostl C., Taillieu T. (2008) Toward a relational concept of uncertainty: about knowing too little, knowing too differently and accepting not to know. Ecology and Society 13 (2): 30

xiii) Butler D., Davies J. (2011). Urban Drainage. Spon. 3rd Ed.

xiv) Cavill S., Sohail M. (2003) Accountability in the provision of urban services. Proc. ICE. Municipal Engineer 156. Issue ME4 paper 13445, p235-244.

xv) Centre for Water Sensitive Cities (2012) Blueprint for a water sensitive city. Monash University.

What the student will learn? To develop an understanding of:

- The impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively.
- The extent of Infrastructure, its requirements for energy and how they are met: past, present and future
- The Sustainability of the Environment, including its Aesthetics,
- The potentials of Civil Engineering for Employment creation and its Contribution to the GDP
- The Built Environment and factors impacting the Quality of Life
- The precautions to be taken to ensure that the above-mentioned impacts are not adverse but beneficial.
- Applying professional and responsible judgement and take a leadership role;

Semester V (Third year] Branch/Course Civil Engineering

PCC-CE301	**Mechanics of Materials**	**3L:0T:0P**	**3 credits**

Course Objectives:

The objectives of this course is to impart knowledge of

- Resolution of forces, equilibrium of force systems consisting of static loads
- Obtaining centroids and moments of inertia for various regular and irregular areas.
- Various forces in the axial force members, and to analysis the trusses using various methods,
- Concept of friction for single and connected bodies.
- Basic concepts of dynamics, their behavior, analysis and motion bodies
- Work energy principles and impulse momentum theory and applications to problem solving

Course Description:

After completing this course, the student will be able to:

1. Apply the fundamental concepts of forces, equilibrium conditions for static loads.
2. Determine the centroid and moment of inertia for various sections.
3. Analyse forces in members of a truss using method of joints and method of sections, analyse frictionfor single and connected bodies.
4. Apply the basic concepts of dynamics, their behavior, analysis and motion bodies.
5. Solve problems involving work energy principles and impulse momentum theory.

Proposed Syllabus

Module 1: *Deformation and Strain covering* description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis ofthin, thick and compound cylinder;

Module 2: *Generalized state of stress and strain:* Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.

Module 3:*Momentum Balance and Stresses covering* Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion

Module 4:*Mechanics of Deformable Bodies covering* Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and Indeterminate Trusses,

Module 5:*Force-Stress-Equilibrium covering* Multiaxial Stress and Strain

Module 6: *Displacement – Strain covering* Multiaxial Strain and Multiaxial Stress-strain Relationships

Module 7: *Elasticity and Elasticity Bounds covering*Stress-strain-temperature Relationships and Thin-walled Pressure Vessels,Stress and strain Transformations and Principal Stress, Failure of Materials,

Module 8:*Bending: Stress and Strains; Deflections and Torsion covering* Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

Module 9:*Structural stability;* Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design

Text/Reference Books:

i) Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc Graw Hill, Tokyo, Japan.
ii) Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York, USA.
iii) Kazmi, S. M. A., 'Solid Mechanics" TMH, Delhi, India.
iv) Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004
v) Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
vi) Gere, J. M., and S. P. Timoshenko. *Mechanics of Materials.* 5th ed. Boston: PWS Kent Publishing, 1970.
vii) Ashby, M. F., and D. R. H. Jones. *Engineering Materials, An Introduction to their Properties and Applications.* 2nd ed. Butterworth Heinemann.
viii) Collins, J. A. *Failure of Materials in Mechanical Design.* 2nd ed. John Wiley & Sons, 1993.
ix) Courtney, T. H. *Mechanical Behavior of Materials.* McGraw-Hill, 1990.
x) Hertzberg, R. W. *Deformation and Fracture Mechanics of Engineering Materials.* 4th ed. JohnWiley & Sons, 1996.

xi) Nash, W. A. *Strength of Materials.* 3d ed. Schaum's Outline Series, McGraw-Hill, 1994.

Course Learning Outcomes (CLOs): -

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design a system, component, or process to meet desired needs
- an ability to identify, formulate, and solve engineering problems
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- an ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes

PCC-CE302	Hydraulic Engineering	2L:0T:2P	3 credits

Course Objectives:

The objectives of this course is to impart knowledge of

1. Study the concept of the flow through channels and economical design of channels.
2. Understand the boundary layer theory, concept of drag, lift of streamlined bodies
3. Understand the basics of dimensional analysis and development of non-dimensional equations
4. To understand the basic principles of the hydraulic turbines, pumps and their hydraulic design.

Course Description:

After completing this course, the student will be able to:

1. Ability to solve open channel flow problems through the selection and use of appropriate Equations
2. Knowledge of Boundary layer thickness and applications of Drag and lift on some case studies
3. Ability to perform dimensional analysis for problems in fluid mechanics and develop model studies.
4. Understanding of basics of the hydro-machinery and the components, functions and use of different types of turbines and pumps.
5. Able to prepare the characteristic curves and Assimilation of turbine/pump laws and constants for the hydraulic design

Module 1: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates.Stoke's law, Measurement of viscosity.

Module 2: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definitionof turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram.

Module 3:Boundary Layer Analysis-Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.

Module 4: Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies,Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Module 5: Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Module 6: Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient "n *.Most economical section of ch*annel. Computation of Uniform flow, Normal depth.

Module 7 : Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.

Module 8: Hydraulic Jump- Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types,applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow-Momentum principle, applications: Force on plates, pipe bends, momentsof momentum equation.

Module 9: Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoir problem.

Module 10: Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web based modeling in water resources engineering.

Practical Work:

i) Flow Visualization
ii) Studies in Wind Tunnel
iii) Boundary Layer
iv) Flow around an Aerofoil / circular cylinder
v) Uniform Flow
vi) Velocity Distribution in Open channel flow
vii) Venturi Flume
viii) Standing Wave Flume
ix) Gradually Varied Flow
x) Hydraulic Jump
xi) Flow under Sluice Gate
xii) Flow through pipes
xiii) Turbulent flow through pipes
xiv) Flow visualization
xv) Laminar flow through pipes
xvi) Major losses / Minor losses in pipe

Text/Reference Books:

i) Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, Standard Book House
ii) Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.
iii) Open channel Flow, K. Subramanya, Tata McGraw Hill.
iv) Open Channel Hydraulics, Ven Te Chow, Tata McGraw Hill.
v) Burnside, C.D., "*Electromagnetic Distance Measurement*," Beekman Publishers, 1971.

Course Learning Outcomes (CLOs):

- The students will be able to apply their knowledge of fluid mechanics in addressing problems in open channels.
- They will possess the skills to solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- They will have knowledge in hydraulic machineries (pumps and turbines).

PCC-CE303	Structural Engineering	2L:1T:0P	3 credits

Course Objectives:

The objectives of this course is to impart knowledge of

1. Know the IS codal provisions as applicable for the designs.
2. Understand the design philosophies and basics of RCC structural designs
3. Understand the design principles in flexure, shear and torsion.
4. Learn the design of various components of RCC structures.

Course Description:

The students will be able to

1. Apply their knowledge of structural mechanics in addressing design problems of structural engineering
2. They will possess the skills to solve problems dealing with different loads and Concrete and steel
3. They will have knowledge in structural engineering

Module 1: Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principlesof process of design

Module 2: Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and Earthquake Loads

Module 3: *Materials and Structural Design Criteria:* Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminate structures;

Module 4: *Design of Structural Elements;* Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of Reinforced Concrete Beams forFlexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems

Module 5: *System Design Concepts;* Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection

Text/Reference Books:

i) Nilson, A. H. *Design of Concrete Structures.* 13th edition. McGraw Hill, 2004

ii) McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall,N.J., 2003.

iii) Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, PrenticeHall, 1996

iv) Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWS Publishing, Boston.

v) Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, New York, 1990.

vi) MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, New Jersey, 1997.

vii) Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, PrenticeHall, New Jersey.

viii) Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley, New York.

ix) Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ,(2003).

x) Related Codes of Practice of BIS
xi) Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers, New York.
xii) W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition, John Wiley and Sons, 2000.
xiii) NBC, *National Building Code*, BIS (2017).
xiv) ASCE, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-02*, American Society of Civil Engineers, Virginia, 2002.

Course Learning Outcomes (CLOs):

- The students will be able to apply their knowledge of structural mechanics in addressing design problems of structural engineering.
- They will possess the skills to solve problems dealing with different loads and concrete and steel
- They will have knowledge in structural engineering

PCC-CE304	Geotechnical Engineering	2L:0T:2P	3 credits

Course Objectives

The objectives of this course is to impart knowledge of

1. Introduction of Particulate Mechanics further to the solid and fluid mechanics
2. Characterization and classification of soils based on laboratory and field experiments
3. Understand Seepage, Strength and Compressibility characteristics of soils and learn the analysis of applications involving them

Course Description:

After completing this course, the student will be able to:

1. Competence in understanding the soil and the mechanisms associated with it.
2. Ability to analyze the systems involving soil mechanics
3. Competence for application of principles of soil mechanics in Foundation Engineering to be learned in the next semester.

Module 1: *Introduction*–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships-Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content-specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method,nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

On completion of this module, the students must be able to:

- Understand the different types of soil based on their formation mechanism;
- Understand the various phase diagrams and derive various phase relationships of the soil;
- Perform various laboratory experiments to determine moisture content, specific gravity;
- Perform field experiments to estimate the field density of the soil mass.

Module 2: *Plasticity Characteristics of Soil* - Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.

On completion of this module, the students must be able to:

- Understand the behaviour of soils based on their moisture contents;
- Perform laboratory experiments to estimate various Atterberg limits and evaluate index properties of soils;
- Classify any soils based on their particle size distribution and index properties;

Module 3: *Permeability of Soil* - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method.

Field method: pumping- in test, pumping- out test. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis- Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets.

On completion of this module, the student must be able to:

- Determine the permeability of soils through various laboratory and field tests;
- Analytically calculate the effective permeability of anisotropic soil mass;
- Determine the seepage quantities and pore water pressures below the ground;

- Graphically plot the equipotential lines and flow lines in a seepage flow.

Module 4:*Effective Stress Principle* - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.
On completion of this module, the student must be able to:

- Understand the physical significance of effective stress and its relation with pore pressure;
- Plot various stress distribution diagrams along the depth of the soil mass;
- Understand the effect of capillary action and seepage flow direction on the effective stress ata point in the soil mass.

Module 5: *Compaction of Soil*-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.
On completion of this module, the student must be able to:

- Perform laboratory test to determine the maximum dry density and optimum moisture contentof the soil;
- Variation in compaction curve with compaction effort and soil type;
- Determine the compactive effort required to obtain necessary degree of compaction in-situ;
- Differentiate among various field methods of compaction and their usage based on the type ofsoil.

Module 6:*Stresses in soils* – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastic theory.
On completion of this module, the student must be able to:

- Analytically compute the vertical stress in a semi-infinite soil mass due to various loadingconditions;
- Plot isobars due various loading conditions.

Module 7:*Consolidation of Soil* - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.
On completion of this module, the student must be able to:

- Understand the basic mechanism of consolidation of soil;
- Determine various consolidation parameters of soil through laboratory test;
- Evaluate ground settlements against time.

Module 8:*Shear Strength* - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses,Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters.unconfined compression test, vane shear test
On completion of this module, the student must be able to:

- Determine graphically and analytically the stress state in any plane of the soil mass;
- Perform various shear strength tests and appreciate the different field conditions which theysimulate;
- Understand the significance of shear strength parameters in various geotechnical analyses;
- Evaluate the stiffness of soil using shear strength parameters

Module 9:*Stability of Slopes* - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.

On completion of this module, the student must be able to:

- Differentiate various modes of slope failure;
- Evaluate factor of safety of infinite slopes based on different ground conditions; Understandvarious methods for computation of factor of safety for finite slopes.

Module 10:*Soil Exploration*- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

On completion of this module, the student must be able to:

- Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground;
- Understand various site investigation techniques and their in-situ applications;
- Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT,etc.

Practical Work: List of tests on-

i) Field Density using Core Cutter method.
ii) Field Density using Sand replacement method.
iii) Natural moisture content using Oven Drying method.
iv) Field identification of Fine Grained soils.
v) Specific gravity of Soils.
vi) Grain size distribution by Sieve Analysis.
vii) Grain size distribution by Hydrometer Analysis.
viii) Consistency limits by Liquid limit
ix) Consistency limits by Plastic limit
x) Consistency limits by Shrinkage limit.
xi) Permeability test using Constant-head test method.
xii) Permeability test using Falling-head method.
xiii) Compaction test: Standard Proctor test.
xiv) Compaction test: Modified Proctor test.
xv) Relative density.
xvi) Consolidation Test.
xvii) Triaxial Test (UU)
xviii) Vane shear test
xix) Direct Shear Test
xx) Unconfined Compression Strength Test.

Text/Reference Books:

i) Soil Mechanics by Craig R.F., Chapman & Hall
ii) Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
iii) An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., PrenticeHall, NJ
iv) Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
v) Principles of Foundation Engineering, by Braja M. Das, Cengage Learning

Course Learning Outcome(CLOs)-

- The students will gain an experience in the implementation of Geotechnical Engineering on engineering concepts which are applied in field Geotechnical Engineering
- The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems of designing of structures.
- The students will learn to understand the theoretical and practical aspects of geotechnical engineering along with the design and management applications.

PCC-CE305	Hydrology and Water Resources Engineering	2L:2T:0P	3 credits

Course Objectives:

The objectives of this course is to impart knowledge of

1. Understanding the importance of Hydrology and its applications
2. Introduction to Hydrological processes and estimation of Design flood
3. Basic concepts and assessment of groundwater flows
4. Applications of statistical models in Hydrology
5. Introduction and assessment of soil-water-plant relationship

Course Description:

After completing this course, the student will be able to:

1. Estimation of Design flood for Water Resources structures
2. Computation of drawdown and yield in aquifers
3. Development of Rainfall – Runoff relationship
4. Determination of crop – water requirements

Module 1: *Introduction* - hydrologic cycle, water-budget equation, history of hydrology, worldwater balance, applications in engineering, sources of data.

Module 2: *Precipitation* - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Module 3:*Abstractions from precipitation* - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltration indices.

Module 4:*Runoff* - runoff volume, SCS-CN method of estimating runoff volume, flow-duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.

Module 5: *Ground water and well hydrology* - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

Module 6:*Water withdrawals and uses* – water for energy production, water for agriculture, water for hydroelectric generation; flood control. Analysis of surface water supply, Water requirement of crops-Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation.

Module 7:*Distribution systems* - canal systems, alignment of canals, canal losses, estimation of design discharge. Design of channels- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Canal outlets: non-modular, semi-modular and modular outlets. Water logging: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

Module 8: *Dams and spillways* - embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

Text/Reference Books:

i) K Subramanya, Engineering Hydrology, Mc-Graw Hill
ii) K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
iii) K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.
iv) G L Asawa, Irrigation Engineering, Wiley Eastern
v) L W Mays, Water Resources Engineering, Wiley.
vi) J D Zimmerman, Irrigation, John Wiley & Sons
vii) C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Course Learning Outcomes(CLO):

At the end of the course, students must be in a position to:

- Understand the interaction among various processes in the hydrologic cycle
- Apply the application of fluid mechanics and use of computers in solving a host of problems inhydraulic engineering
- Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for design of hydraulic structures
- Understand the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions
- Understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field of water resources
- Apply the principles and applications of remote sensing, GPS and GIS in the context to hydrological extreme flood and drought events in water resources engineering

PCC-CE306	Environmental Engineering	2L:2T:0P	3 credits

Course Objectives:

- To create awareness and impart basic knowledge about the environment and its allied problems.
- To know the functions of ecosystems.
- To understand importance of biological diversity.
- To study different pollutions and their impact on environment.
- To know social and environment related issues and their preventive measures.

Course Description:

After completing this course, the student will be able to:

1. Adopt environmental ethics to attain sustainable development.
2. Develop an attitude of concern for the environment.
3. Conservation of natural resources and biological diversity.
4. Creating awareness of Green technologies for nation's security.
5. Imparts awareness for environmental laws and regulations.

Module 1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2: *Sewage-* Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water-Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module 4: *Noise-* Basic concept, measurement and various control methods.

Module5:*Solid waste management-*Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods-Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Module 6: *Building Plumbing*-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittings used.

Module 7: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Practical Work: List of Experiments

i) Physical Characterization of water: Turbidity, Electrical Conductivity, pH
ii) Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
iii) Alkalinity and acidity, Hardness: total hardness, calcium and magnesium hardness
iv) Analysis of ions: copper, chloride and sulfate
v) Optimum coagulant dose
vi) Chemical Oxygen Demand (COD)
vii) Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
viii) Break point Chlorination
ix) Bacteriological quality measurement: MPN,
x) Ambient Air quality monitoring (TSP, RSPM, SOx, NOx)
xi) Ambient noise measurement

Text/Reference Books:

i) Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall,New Jersey.
ii) Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
iii) Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - HillInternational Editions, New York 1985.
iv) MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill, New Delhi.
v) Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
vi) Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999
vii) Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication
viii) Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Healthand Environmental Engineering Organization, Ministry of Urban Development.

Course Learning Outcomes (CLOs):

After successfully studying this course, students will:

i) Understand the impact of humans on environment and environment on humans
ii) Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
iii) Be able to plan strategies to control, reduce and monitor pollution.
iv) Be able to select the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air.
v) Be conversant with basic environmental legislation.

PCC-CE307	Transportation Engineering	2L:0T:2P	3 credits

Course Objectives

The objectives of this course is to impart knowledge of

1. To study various signal design concepts
2. Emphasize the significance of traffic signs and road markings
3. To understand various techniques of pavement construction and maintenance
4. To know the concepts related to transport planning and economic analysis

Course Description:

After completing this course, the student will be able to:

1. Apply the concepts of signal design
2. Knowledge regarding construction techniques of flexible and rigid pavements
3. Understand concepts of transportation planning process • Perform economic analysis of transportation projects

Module 1: Highway development and planning-Classification of roads, road development in India, Currentroad projects in India; highway alignment and project preparation.

Module 2: Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Module 3:Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems

Module 4:Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems

Module 5: Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements-components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems

Text/Reference Books:

i) Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
ii) Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
iii) Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning
iv) Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineeringand Traffic Analysis', 4th Edition, John Wiley
v) Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
vi) Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

Course Learning Outcomes (CLO):

On completion of the course, the students will be able to:

- carry out surveys involved in planning and highway alignment
- design the geometric elements of highways and expressways
- carry out traffic studies and implement traffic regulation and control measures andintersection design
- characterize pavement materials and
- design flexible and rigid pavements as per IRC

HSMC255	Professional Practice, Law & Ethics	2L:0T:0P	2 credits

Basic elements of civil engineering professional practice are introduced in this course. Roles of all participants in the process-owners, developers, designers, consultants, architects, contractors, and suppliers

- are described. Basic concepts in professional practice, business management, public policy, leadership, and professional licensure are introduced. The course covers professional relations, civic responsibilities, and ethical obligations for engineering practice. The course also describes contracts management, and various legal aspects related to engineering. Further, the course familiarizes students with elementary knowledge of laws that would be of utility in their profession, including several new areas of law such as IPR, ADR.

The course is designed to address the following:

- To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession
- To develop some ideas of the legal and practical aspects of their profession

Proposed Syllabus

Professional practice covering the respective roles of the various stakeholders in the profession of civil engineering and the factors governing the same; Professional ethics relating to civil engineering; Various aspects of contracts relating to construction and management of contracts; types of contractual and other disputes in the profession and methods of dispute resolution; legal aspects relating to employment and service conditions of labour; intellectual property rights and their legal framework

Modules:

Module 1 A- Professional Practice – Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities)(certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards); Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards)

Module 1 B- Professional Ethics – Definition of Ethics, Professional Ethics, Business Ethics, Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics as defined in the website of Institution of Engineers (India); Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Module 2:*General Principles of Contracts Management: Indian Contract Act, 1972 and amendments* covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /"Red Flag" conditions; Contract award & NoticeTo Proceed; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance; Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping, Bid fixing, Cartels); Reverse auction; Case Studies; Build-Own-Operate & variations; Public-Private Partnerships; International Commercial Terms;

Module 3 :*Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system:* Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats

Module 4 :*Engagement of Labour and Labour & other construction-related Laws:* Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017

Module 5 : *Law relating to Intellectual property:* Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

Text/Reference Books:

i) B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
ii) The National Building Code, BIS, 2017
iii) RERA Act, 2017
iv) Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
v) Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai
vi) Avtarsingh (2002), Law of Contract, Eastern Book Co.
vii) Dutt (1994), Indian Contract Act, Eastern Law House
viii) Anson W.R. (1979), Law of Contract, Oxford University Press
ix) Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration
x) Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
xi) T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
xii) Bare text (2005), Right to Information Act
xiii) O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
xiv) K.M. Desai(1946), The Industrial Employment (Standing Orders) Act
xv) Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
xvi) Vee, Charles & Skitmore, Martin (2003) Professional Ethics in the Construction Industry,Engineering Construction and Architectural management, Vol.10, Iss2,pp 117-127, MCB UP Ltd
xvii) American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study and Application
xviii) Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
xix) Engineering Ethics, National Institute for Engineering Ethics, USA
xx) www.ieindia.org
xxi) Engineering ethics: concepts and cases – C. E. Harris, M.S. Pritchard, M.J.Rabins
xxii) CONSTRUCTION CONTRACTS, http://www.jnormanstark.com/contract.htm

xxiii) Internet and Business Handbook, Chap 4, CONTRACTS LAW,
xxiv) http://www.laderapress.com/laderapress/contractslaw1.html
xxv) Contract&Agreements
xxvi) http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
xxvii) Contracts, http://206.127.69.152/jgretch/crj/211/ch7.ppt
xxviii) Business & Personal Law. Chapter 7. "How Contracts Arise",
xxix) http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
xxx) Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
xxxi) IV. TYPES OF CONTRACTS AND IMPORTANT PROVISIONS,
xxxii) http://www.worldbank.org/html/opr/consult/guidetxt/types.html
xxxiii) Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02),
xxxiv) http://www.sandia.gov/policy/14g.pdf

Goals & Outcomes:

i) To familiarise the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession

ii) To give a good insight into contracts and contracts management in civil engineering, dispute resolution mechanisms; laws governing engagement of labour

iii) To give an understanding of Intellectual Property Rights, Patents.

iv) To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession

v) To develop good ideas of the legal and practical aspects of their profession

Semester VI (Third year] Branch/Course Civil Engineering

PCC-CE308	**Construction Engineering & Management**	**2L:1T:0P**	**3 credits**

Course Objectives

The objectives of this course is to impart knowledge of

1. Describe different techniques of construction management projects
2. Illustrate economics & resource allocation for construction projects
3. Understand the basic concepts of optimization
4. Study the Safety Engineering practices for construction management projects
5. Comprehend the preparation of contracts and construction equipment

Course Description:

After completing this course, the student will be able to:

1. Application of network analysis to construction projects
2. Ability in applying resource leveling and smoothing to various projects
3. Utilization of Optimization techniques for proper project management
4. Knowledge of accident rates and their estimation for various case studies
5. Acquaintance with types of contracts and application of construction equipment's

Module 1: *Basics of* Construction- Unique features of construction, construction projects-types and features, phases of a project, agencies involved and their methods of execution;

Module 2: Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculationof probability of completion.

Module 3: Construction Methods basics: Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges.

Module 4: Construction Equipment basics*:* Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities

Module 5: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices in Construction

Module 6:*Project Monitoring & Control-* Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Module 7:*Contracts Management basics:* Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Module 8:*Construction Costs: Make- up of construction costs;* Classification of costs, time-cost trade-off in construction projects, compression and decompression.

Text/Reference Books:

i) Varghese, P.C., "*Building Construction"*, Prentice Hall India, 2007.
ii) *National Building Code,* Bureau of Indian Standards, New Delhi, 2017.
iii) Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
iv) Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
v) Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
vi) Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
vii) Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Course Learning Outcome(CLOs)-

On completion of the course, the students will have**:**

- An idea of how structures are built and projects are developed on the field
- An understanding of modern construction practices
- A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics
- A basic ability to plan, control and monitor construction projects with respect to time and
- cost
- An idea of how to optimise construction projects based on costs
- An idea how construction projects are administered with respect to contract structures
- and issues.
- An ability to put forward ideas and understandings to others with effectivecommunication processes

S.No	Module (No of Lectures in brackets)	Tutorials
1	Basics of Construction (2)	
2	Construction Planning (6)	Develop a WBD structure for the construction of one storeyed building; Develop a bar chart for the construction of this building, including finishing activities, assuming reasonable activity durations.
3	Construction Methods basics (6)	Develop a CPM chart for a 5 span bridge on open foundations. Develop a comparative table for a 10-storeyed building constructed by at least three different methods, listing their pros and cons.
4	Construction Equipment Basics (3)	Develop a Gantt Chart for the construction of a two storeyed precast framed structure, including open foundations, along with list of equipment resources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to placing of concrete at 3m height above ground level; show all equipment resources required, along with a site layout.
5	Planning and Organizing Construction Site and Resources (4)	For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw S-curves for concrete placing and blockwork done over the period.
6	Project Monitoring and Control (4)	Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq. m. plinth area.
7	Contract Management basics (3)	Assuming a 4 month delay in a construction contract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to act as the Contractor. One person to act as Arbitrator/ Judge.
8	Construction Costs (2)	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximate cost of a 3 storey, 400 sqm plinth area building.
	Total: 30 Lectures	15 Tutorials

PCC-CE309	Engineering Economics, Estimation & Costing	2L:1T:4P	5 credits

Course Objectives

The objectives of this course is to impart knowledge of

1. Understand the basic principles and specifications for estimations
2. Know the basic procedures for Tenders and Tender documents
3. Understand the detailed estimation of buildings, roads and Irrigation structures

Course Description:

1. Will be able to prepare tender documents
2. Will be able to prepare estimates for various engineering structures
3. Will be able to prepare schedule for civil engineering works

Module 1:Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & CostControl –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2 lectures)

Module 5: *Estimation /* Measurements for various items- Introduction to the process of Estimation; Useof relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials forbuildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying (7 lectures)

Module 6: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3 lectures)

Module 8: Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture)

Term Work Assignments may include:

a) Deriving an approximate estimate for a multi-storeyed building by approximate methods.
b) Detailed estimate for the following with the required material survey for the same.

- a) Ground plus three storied RCC Framed structure building with blockwork walls
- b) bridge with minimum 2 spans
- c) factory building
- d) road work
- e) cross drainage work
- f) Ground plus three storied building with load-bearing walls
- g) Cost of finishes, MEP works for (f) above
- h) Preparation of valuation report in standard Government form.
- i) Assignments on rate analysis, specifications and simple estimates.
- j) Detailed estimate of minor structure.
- k) Preparation of Bar bending schedule.

Text/Reference Books:

- i) Mankiw Gregory N. (2002), *Principles of Economics,* Thompson Asia
- ii) V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* Tata McGraw Hill
- iii) Misra, S.K. and Puri (2009), *Indian Economy,* Himalaya
- iv) Pareek Saroj (2003), *Textbook of Business Economics,* Sunrise Publishers
- v) M Chakravarty, Estimating, Costing Specifications & Valuation
- vi) Joy P K, Handbook of Construction Management, Macmillan
- vii) B.S. Patil, Building & Engineering Contracts
- viii) Relevant Indian Standard Specifications.
- ix) World Bank Approved Contract Documents.
- x) FIDIC Contract Conditions.
- xi) Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
- xii) Typical PWD Rate Analysis documents.
- xiii) UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory andPractice including Specification and Valuations,2016
- xiv) Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016

Course Learning Outcome(CLOs)-

On completion of the course, the students will:

- Have an idea of Economics in general, Economics of India particularly for public sector agencies andprivate sector businesses
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one ofmore economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or moreeconomic alternatives.
- Be able to understand the technical specifications for various works to be performed for a project andhow they impact the cost of a structure.
- Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their costrates and build up the overall cost of the structure.
- Be able to understand how competitive bidding works and how to submit a competitive bid proposal

Professional Elective Courses-I

PEC-CEEL302	Transportation Engineering	2L:1T:0P	3 credits

Course Objectives

The objectives of this course is to impart knowledge of

1. Awareness about transportation engineering
2. Emphasize the significance of geometric design of highways with specifications and standards
3. Create the awareness of airport engineering basic things and railway engineering
4. Impart knowledge on pavement engineering traffic engineering, railway engineering and airport engineering.

Course Description:

After completing this course, the student will be able to:

1. Assimilation of the various concepts of highway geometric design
2. Application of concepts related to basic traffic engineering
3. Knowledge regarding the different types of thickness design of rigid and flexible pavements
4. Understand element of permanent way and application of principles of geometric design railway track
5. Understand basic element of airport engineering and application of basic design concepts of runway alignment

1. **Pavement Materials**. Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties and tests on road aggregates for flexible and rigid pavements. Bitumen: Origin, preparation, properties and tests, constitution of bituminous road binders; requirements; Criterion for selection of different binders.Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests,Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. bituminous mix design methods and specifications.Weathering and Durability of Bituminous Materials and Mixes.Performance based Bitumen Specifications; Superpave mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and designof mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials.

2. **Pavement Design.** Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements.Stresses and Deflections in Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads.Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC

3. **Geometric Design of Highways:**Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors; Design Elements: Sight distances, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit

and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems; Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness; Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design Of Intersections: Characteristics and design considerations of at-grade intersections;; Rotary intersections; Grade separations and interchanges -; Design of Parking lots

4. **Airport Planning and Design**:Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection; Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity - Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity; Air Traffic Management: Navigational aids: ground based systems, satellite based systems – Air traffic control and surveillance facilities – Airfield lighting - air traffic management.

5. **Intelligent Transportation Systems:**Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS); ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

6. **Railway Engineering**. Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers; ballast; subgrade and formation, rack fittings and fastenings, creep of rails, geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations and yards; railway tunneling; signaling and interlocking; maintenance of railways and high speed trains.

7. **High Speed Rail Engineering**. Development, engineering, design and construction of high-speed rail (HSR) passenger transport systems with particular emphasis on the unique engineering elements of HSR technology. Key elements of HSR systems and subsystems including: core systems (trains, power, signal, communication and control), track system and civil infrastructure (earthwork, bridges, viaducts and tunnels). Also covered are basic design and construction of HSR stations and rolling stock maintenance facilities.

8. **Urban Transportation Planning:**Urban morphology - Urbanization and travel demand – Urban activity systems and travel patterns – Systems approach – Trip based and Activity based approach - Urban Transportation Planning – Goals, Objectives and Constraints - Inventory, Model building, Forecasting and Evaluation - Study area delineation – Zoning - UTP survey; Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models -

Category analysis - Trip distribution models – Growth factor models, Gravity model and Opportunity modes; Modal split models – Mode choice behavior – Trip end and trip interchange models - Probabilistic models - Utility functions - Logit models - Two stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multi path assignment - Route-choice behavior; Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models - Quick response techniques - Non-Transport solutions for transport problems; Preparation of alternative plans - Evaluation techniques - Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

9. **Pavement Construction and Management:** Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and

surface course layers and their choice; Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints; Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications; Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - nondestructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques; Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques– AASTHO, CRRI and HDM models, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, lifecycle costing,

10. **Transportation Economics:** Introductory Concepts in Transportation Decision Making: Overall transportation project development, budgeting, financial planning, the process of transportation project development, models associated with transportation impact evaluation; Transportation costs -Classification of transportation costs, transportation agency costs, transportation user costs, general structure and behavior of cost functions and road pricing. Estimating Transportation Demand and Supply - supply equilibration, dynamics of transportation demand and supply, elasticity of travel demand and supply, classification of elasticity; Vehicle operating costs: Fuel costs - Maintenance and spares, Depreciation - Crew costs - Value of travel time savings - Accident costs. Economics of traffic congestion - Pricing policy; Economic analysis of projects - Methods of evaluation - Cost-benefit ratio, first year rate of return, net present value, and internal-rate of return methods; Indirect costs and benefits of transport projects; Financing of road projects - methods – Private Public Partnership (PPP) - Toll collection - Economic viability of Design-Build-Operate-Transfer Schemes – Risk Analysis – Value for Money analysis - Case Studies.

11. **Port and Harbour Engineering:** Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways,

locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigationalaids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile; Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, nationalwaterways.

12. **Traffic Engineering and Management:** Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships,

    methods for future projection; Design Hourly Volume For Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept;Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalised and signalised intersections. Problems in MixedTraffic flow; Case studies; Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions; Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects Of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies. Formulation of system models.

13. **Public Transportation Systems:** Public Transport: Definitions, modes of public transport and comparison, public transport travel characteristics, trip chaining, technology of bus, rail, rapid transit systems, basic operating elements; Transit Network Planning: Planning Objectives, principles, considerations, transit lines – types, geometry and characteristics, transit routes and their characteristics, timed transfer networks, prediction of transit usage, evaluation of network, accessibility considerations; Transit Scheduling: Components of scheduling process, determination of service requirements, scheduling procedure, marginal ridership, crew scheduling;Transit Agency and Economics: Organizational structure of transit agency, management and personnel, transit system statistics, performance and economic measures, operations, fare structure; Design of Facilities: Design of bus stops, design of terminals – principles of good layout, types of layout, depotlocation, twin depot concept, crew facilities and amenities.

14. **Infrastructure Planning and Management:** Introduction: Definition of basic terminologies, role of infrastructure in economic development, types of infrastructure, measurement of infrastructure capacity, bases for quantification of demand and supply of various types of infrastructure, Indian scenario in respect of adequacy and quality. Infrastructure Planning: Goals and objectives of infrastructure planning; Identification and quantification of the casual factors influencing the demand for infrastructure; review and application of techniques to estimate supply and demand for infrastructure; use of econometric, social and land use indicators and models to forecast the demand and level of service of infrastructure and its impact on land use; critical review of the relevant forecasting techniques; infrastructure planning to identify and prioritize preferred areas for development; Integration of strategic planning for infrastructure at urban, regional and national levels; case studies in infrastructure planning. Infrastructure Management: Concepts, Common aspects of urban and rural infrastructure management systems; pavement and bridge management systems, Integrated infrastructure management, Case studies; Emerging trends in infrastructure: Overview of Public-Private Sector Participation in infrastructure projects, Understanding stakeholders' concerns, regulatory framework, risk management in infrastructure projects, public policy for infrastructure Sectoral Overview: Highways, railways, waterways, airports, urban and rural infrastructure: roads, housing, water supply, sanitation – case study examples.

Course Learning Outcome(CLOs)-

- An ability to apply knowledge of math, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to function on multi-disciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of ethical and professional responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- A recognition of need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use techniques, skills and modern engineering tools necessary for engineering practice

Professional Elective Courses-II

PEC-CEEL304	**Construction Engineering & Management**	**2L:1T:0P**	**3 credits**

1. **Construction Productivity.** Definition of Productivity, Impact of productivities on construction duration and costs; Measuring productivities of construction equipment, Staff and Labour and typical benchmarks for the same; Productivity analysis from Daily Progress Reports; Lean Construction concepts of Value Adding activities, Non-Value Adding Activities and Non-Value Adding butNecessary Activities; Productivity measurements by special Lean Construction-oriented field methods such as Work Sampling, Takt time analysis, Foreman Delay Surveys; Productivity improvement measures such as Value Stream Mapping, Location-Based management Systems, 5S, good Housekeeping, etc.; use of specialist software such as Vico for productivity studies.

2. **Building Construction Practice.** Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick –– weather and water proof – roof finishes – acoustic and fire protection; Sub Structure Construction- Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points - Dewatering and stand by Plant equipment for underground open excavation; Super Structure Construction- Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavydecks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks;

3. **Construction Equipment & Automation*:***Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; plastering machines; Prestressing jacks and grouting equipment; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities; Use of Drones for spread out sites; Use of robots for repetitive activities

4. **Contracts Management. Contract Management** – Introduction, Importance of Contracts, Overview of Contract Management, Overview of Activities in Contract Management; Planning and People- Resource Management; Types of Contracts, Parties to a Contract; Contract Formation, Formulation of Contract, Contract Start-Up, Managing Relationships; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Notices under contracts; Conventional and Alternative Dispute Resolution methods. Various Acts governing Contracts; Contract Administration and Payments- Contract Administration, Payments; Contract Various Situations-Contract Management in NCB Works, Contract Management in ICB Works Contracts, Contract of Supply of Goods-Design, Supply and Installation Contracts, Contract Management in Consultancy,; Managing Risks and Change- Managing Risks, Managing Change; Contract Closure and Review-Ending a Contract, Post-Implementation Review; Legal Aspects in Contract Management-Contract Management Legal View, Dispute Resolution, Integrity in Contract Management; Managing Performance- Introduction, Monitoring and Measurement

5. **Construction Project Planning& Systems.** Definition of Projects; Stages of project planning: pre- tender planning, pre-construction planning, detailed construction planning, role of client andcontractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks.PERT-Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion. Allocation of Resources- materials, equipment, staff, labour and finance; resource levelling and optimal schedules; Project organisation, documentation and reporting systems. Control & monitoring; Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management; Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and levelling. Common Good Practices in Construction; *Project Monitoring & Control-* Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

6. **Construction Cost Analysis.** Introduction to the application of scientific principles to costs and estimates of costs in construction engineering; concepts and statistical measurements of the factors involved in direct costs, general overhead costs, cost markups and profits; and the fundamentals of cost recording for construction cost accounts and cost controls.

7. **Repair & Rehabilitation of Structures**. Maintenance and Repair Strategies Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration; Strength and Durability Of Concrete- Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness; Special Concretes- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes; Techniques for Repair and Protection Methods- Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection; Repair, Rehabilitation and Retrofitting of Structures- Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting; Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs.Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques – Engineered demolition methods – Case studies.

8. **Sustainable Construction Methods**. Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls); Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges; Identification of cutting edge sustainable construction materials, technologies, and

project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity. Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam

9. **Construction Engineering Materials.** Design, production, application, specification, and quality control of construction materials unique to civil engineering. Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes

Professional Elective Courses-III

PEC-CEEL306	Environmental Engineering	2L:1T:0P	3 credits

1. **Ecological Engineering**. Characteristics of rivers and lakes which affect the management of domestic and industrial wastewaters; chemical hazards assessment, surveillance and biomonitoring, and review of regulations governing effluents.

2. **Stream Ecology**. Description of physical, chemical, and biological characteristics in streams and rivers including an integrated treatment of the environmental factors affecting the composition and distribution of biota; emphasizes the application of ecological engineering principles in aquatic ecosystem protection.

3. **Environmental Systems**. Introduction to the concepts and applications of environmental systems analysis. Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy. Economic analysis, including benefit-cost analysis and management strategies.Concepts of tradeoff, non- inferior sets, single and multi-objective optimization. Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.

4. **Water Quality Engineering**. Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters.

5. **Transport of water and wastewater.** The objective of the course is to make students gain insight into how the water and wastewater gets transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems. Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation. Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer lay out, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety. Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance

6. **Environmental Laws and Policy.** Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc., Introduction to trade and environment. International environmental laws, Right to Environment as Human Right, International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

7. **Physico-Chemical Processes for water and wastewater treatment.** The Objective of this course is to provide an in depth understanding of physical and physico-chemical processes used for water and wastewater treatment systems and to provide capability to design such systems. Water purification in natural systems, physical processes, chemical processes and biological processes. Primary, secondaryand tertiary treatment. Unit operations, unit processes. Aeration and gas transfer**.** Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation

   processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects. Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters,

mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, pre-coat filtration, design aspects. Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal; Adsorption, adsorption equilibria and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption. Ion Exchange-exchange processes, materials and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodyalisis

8. **Biological processes for contaminant removal.**Understanding of basics of microbiology, metabolism and energetic, bio kinetic parameter, reactors and reactor analyses. Characterization of waste. Aerobic, anaerobic and anoxic systems. Suspended and attached growth biological systems. Activated Sludge processand process modifications, Process design considerations, Treatment Ponds and aerated Lagoons, aerobic pond, facultative pond, anaerobic ponds, polishing ponds, constructed wet lands etc. Attached Growth Biological Treatment Systems, Trickling Filters, Rotating Biological Contactors, Activated Biofilters, Moving bed biological reactor (MBBR), Sequential Batch reactors (SBR), Membrane Biological Reactors (MBR) etc. Anaerobic processes, Process fundamentals, Standard, high rate and hybrid reactors, Anaerobic filters, Expanded /fluidized bed reactors, Upflow anaerobic sludge blanket reactors, Performance and design aspects, Expanded granular bed reactors, Two stage/phase anaerobic reactors. Sludge Digestion, anaerobic digestion, aerobic digestion

9. **Rural water supply and onsite sanitation systems.** Attributes of water supply systems, drinking water quality. Relationships between diseases and water quality, hygiene and sanitation. Need for water treatment. Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron.Onsite sanitation systems: Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets. Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.

10. **Air and Noise Pollution Control.** Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect. Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality. Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods

11. **Solid and hazardous waste management.** Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal. Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground

water contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

12. **Water and Air Quality Models.** Introduction to Mathematical Models: water quality model development, calibration and verification cost: benefit analysis using models, Model requirements and limitations. D.O. Models for Streams: Dissolved oxygen model for streams sources and sinks of dissolved oxygen estimation of system parameters Streeter Phelps model oxygen 'sag' curve-determination of deoxygenation and re-aeration coefficients- Benthal oxygen demand mass transport mechanisms- Models for Estuary and Lakes: Physical chemical and biological processes in estuaries; Air quality models: Micrometeorological processes, wind rose, dispersion, coefficients and stability classes, Gaussian and dispersion model, Stack height computation, Regional air quality models, Source inventories and significance .

13. **Environmental impact assessment and life cycle analyses.** Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

Professional Elective Courses-IV

PEC-CEEL308	Hydraulics	2L:1T:0P	3 credits

1. **Hydraulic Structures/Irrigation Engineering:** This course should discuss key issues in designing irrigation channels and hydraulic structures used in irrigation systems Estimation of crop water requirement; Design of lined and unlined channels; Analysis for surface and sub-surface flow at hydraulic structures; Design of barrages and weirs; Design of Head and cross regulators; Design of canal falls, transitions and cross drainage works; Design principles for gravity and earthen dams

2. **Pipeline Engineering:** The course should cover key issues for designing and operating pipelines for transmission and distribution of water; Analysis of flow in water transmission and water distribution systems (pump & gravity); optimal design and operation of systems for achieving different goals (including latest tools available for optimization); Extended period simulations, Software for WDN analysis and design, Rehabilitation of pipeline systems; Water auditing, online monitoring and control, leak and burst detection; transient analysis and surge protection; Appurtenances (valves / flow meters etc.); Selection of pipe material; Jointing details; Pipe laying and testing; Structural design for buried and surface mounted pipes
   Pre-Requisite: Basic course in Hydraulic Engineering

3. **Unsteady Open Channel Flow:** This course should discuss how to analyze for unsteady flows in open channels; Derivation of 1-D and 2-D shallow water flow equations; Consideration for non-hydrostatic pressure distribution; Basics of numerical methods: Finite-Difference and Finite Element Methods; Latest shock capturing Finite Volume methods for solving 1-D and 2-D shallow water flow equations; Dambreak flow; Flood routing in large channel networks, Flood routing in compound channels; Flood routing in channels with flood plains, Surface irrigation flow modeling
   Pre-Requisite: Basic course in Hydraulic Engineering

4. **River Engineering:** Knowledge about river behavior is essential for practicing hydraulic and water resources engineers. River Morphology (Bars; Bends and Meanders, Thalweg; Braiding; Bifurcations etc.); Sediment Transport Mechanics (Bed forms, Bed Load transport, Transport of suspended sediment, Critical Shear stress, Sediment Transport Equations); Aggradation and Degradation; Local Scour at Bridge Piers and other Hydraulic Structures. Measurements in Rivers (Stage measurements, Channel geometry, Discharge, Sediment samplers and suspended and bed load measurement), Physical river Models (fixed and movable bed models; sectional models, distorted Models), Mathematical models for aggradations, degradation and local scour, River Protection and Training Works (Revetments, Dikes, Gabions, Spurs, Bank Protective measures and Bed control structures), Design of river training and flood protection structures, Diversion and Cofferdams; Riverregulations systems; Dredging and Disposal, River restoration

5. **Hydraulic Modeling:** The main objective of this course is to introduce various concepts which will help in designing physical hydraulic models. Basics of Hydraulic Modelling (similarity mechanics, model laws, distinction between numerical and hydraulic models, classification of hydraulic modelling, materials used in the model, scale effect, design, construction, operation and interpretation of the results); Role of instrumentation and data processing; Gravity dominated models(modelling of energy dissipaters, overflow spillways, siphon spillways, bridge piers, vortex formation, cavitation, flow induced vibrations); Gravity friction models: (pumped flow models, ship models, surge tank models); Friction dominated models; River models with fixed and mobile bed; Basin and reservoir models; Tidal models with fixed and mobile bed; estuarine models; harbor and breakwater models, models of offshore structures; Hybrid and Analogue models; Scope and limitations of hydraulic modelling, complementary aspects of numerical and hydraulic modelling.

6. **Basics of Computational Hydraulics.** Derivation of governing equations for flow and transport in surface and sub-surface (saturated and unsaturated flow); Equations for reactive transport; Coupled

surface and sub-surface flow models; Basics of finite difference, finite element and finite volume methods (consistency, stability, convergence, order of accuracy, computational efficiency); application of numerical methods for solving flow and transport equations, fully coupled and iteratively coupled models; Model simplification, Parameter estimation (Model calibration and validation), Computational Fluid Dynamics (CFD) software for three-dimensional turbulent flow modeling, Software for sub-surface flow simulation

7. **Transients in Closed Conduits:** This course should cover key issues for understanding the unsteadyflow in pipes (water hammer) and designing for surge protection**;** Differential equations for unsteady pipe flow; Characteristic method for solution; Formulation of boundary conditions; transients in pumping mains (power failure; pump start up); transients in penstocks of hydro-electric schemes; analysis for transient control using surge tanks; air chambers; air valves; pressure regulating valves etc.; Emphasis should be on development of computer programs for transient analysis; awareness about commercially available software for transient analysis
   Pre-Requisite: Basic course in Hydraulic Engineering

8. **Groundwater Engineering**: The main objective is to provide sufficient knowledge to the students about the groundwater hydrology, well hydraulics and well construction, geo-physical explorations, groundwater quality and management of groundwater resources; Problems and perspectives regarding groundwater in India; Hydrogeology: Darcy's Equation; flow characteristics; general flow equations; unsaturated flow; Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic well losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: Construction; completion, development, protection and rehabilitation of wells; Groundwater quality; Groundwater Management: Basin management, investigations, conjunctive use, modeling, artificial recharge; Saline water intrusion

9. **Surface Hydrology.** Study of descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; discusses principles of hydrologic processes and presents methods of analysis and their applications to engineering and environmental problems.

Semester VII (Fourth year] Branch/Course Civil Engineering

Professional Elective Course V

PEC-CEEL401	**Hydrology & Water Resources Engineering**	**2L:1T:0P**	**3 credits**

1. **Water Quality Engineering**. Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters.

2. **Surface Hydrology.** Study of descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; discusses principles of hydrologic processes and presents methods of analysis and their applications to engineering and environmental problems.

3. **Environmental Fluid Mechanics.** Incompressible fluid mechanics with particular emphasis on topics in analysis and applications in civil engineering areas; primary topics include principles of continuity, momentum and energy, kinematics of flow and stream functions, potential flow, laminar motion, turbulence, and boundary-layer theory.

4. **Water Resources Field Methods.** Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies. Planning field studies; instruments and protocols for surface-water, ground-water, and water-quality sampling; description of data quality. One-half-day laboratory field trips to streamflow monitoring stations and groundwater monitoring wells nearby.

Professional Elective Course- VI

PEC-CEEL403	Structural Engineering	2L:1T:0P	3 credits

1. **Reliability Analysis of Structures.** Role of reliability in civil engineering; Historical background, random events, random variables, model uncertainty; Common probabilistic models; Important statistical parameters and their estimations, normal, lognormal, extreme value distribution; Fundamental concept of structural reliability; Derivation of stress-strength interface equation, graphical representation, Cornel reliability index, reliability and failure probability computations for simple linear functions; Second moment concepts, First order second moment theory, Hasofer-Lind transformation, Linear and non-linear limit state functions, Solution schemes, geometric interpretation of solution scheme, Rackwitz-Fiessler transformation, First order reliability method; Stochastic models for material strength and loads, Reliability assessment of structural componentand simple civil engineering structures. Prerequisite:

2. **Engineering Risk & Uncertainty.** Identification and modeling of non-deterministic problems in civil engineering design and decision making. Development of stochastic concepts and simulation models and their relevance to real design and decision problems in various areas of civil engineering.

3. **Decision and Risk Analysis.** Development of modern statistical decision theory and risk analysis, and application of these concepts in civil engineering design and decision making; Bayesian statistical decision theory, decision tree, utility concepts, and multi-objective decision problems; modeling and analysis of uncertainties, practical risk evaluation, and formulation of risk-based design criteria, risk benefit trade-offs, and optimal decisions.

4. **Engineering Materials for Sustainability.** Environmental impact of materials; life-cycle assessment; material selection to optimize performance; design, evaluation, and production of green construction materials.

5. **Concrete Materials.** Examines the influence of constituent materials (cements, aggregates and admixtures) on the properties of fresh and hardened concrete; Recycled aggregates recovered from construction and demolition wastes; M-Sand; Light-weight aggregates; Use of Fly Ash in concrete; Fibre-reinforced concrete with various types of metallic and non-metallic fibres; various types of concrete such as Self Compacting Concrete, High Performance Concrete, etc.; mix design; handling and placement of concrete; Effect of revibration of concrete; behavior of concrete under varioustypes of loading and environment; test methods. Laboratory practice is an integral part of the course.

6. **Wood Structures.** Mechanical properties of wood, stress grades and working stresses; effects of strength- reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued- laminated timber and plywood; behavior and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses, rigid frames, arches, and pole-type buildings; and prismatic plates and hyperbolic paraboloids.

7. **Structural Dynamics.** Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multi-degree-of-freedom systems; response spectrum concepts; simple inelastic structural systems; and introduction to systems with distributed mass and flexibility.

8. **Earthquake Engineering.** Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse -Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration - Natural frequencies - Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations); Elements of Seismology; Causes of Earthquake - Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes; Response of Structures to Earthquake;Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes - Base isolation techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures

9. **Industrial Structures.** Industrial steel building frames: Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents, Pressed steel tank, circular tank; Transmission and Communication towers: Types and configuration, Analysis and design; Chimneys; Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and temperature, temperature. Design of chimney; Silos and Bunkers; Jassen’s theory, Airy’s theory, Shallow and deep bins, Rectangular bunkers with slopping bottom, Rectangular bunkers with high side walls; Steel stacks; introduction, force acting on a steel stack, design consideration, design example of stacks; Concrete Shell Structures: Folded plate and cylindrical shell structures; Introduction, structural behaviour of long and short shells, beam and archaction, analysis and design of cylindrical shell structures, Analysis and design of folded plates; Machine foundations; introduction, machine vibration, structural design of foundation to rotary machines, impact machines, vibration characteristics, design consideration of foundation to impact machine, grillage, pile and raft foundation.

10. **Prestressed Concrete.** Study of strength, behavior, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretensioned, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing.

11. **Design of Structural Systems.** The whole structural design process including definition of functional requirements, selection of structural scheme, formulation of design criteria, preliminary and computer- aided proportioning, and analysis of response, cost, and value.

12. **Bridge Engineering.** General; classification of bridges, site selection, geometric and hydraulic design consideration, loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, extrados bridges; arch bridge; Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats; seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance;

13. **Design of Concrete Structures-I.** Study of the strength, behavior, and design of indeterminate reinforced concrete structures, Load and stresses, load combinations, Working stress and limit state approach. Analysis and design of sections in bending – working stress and limit state method, Rectangular and T-sections, Beams with reinforcement in compression, One-way slab. Design for shear and bond, Mechanism of shear and bond failure, Design of shear using limit state concept, Development length of bars; Design of sections in torsion. Design of two-way slabs; Design of flat slab – direct method; Circular slab; Slab type staircase, Placement of reinforcement in slabs; Voided slab. Design of compression members, Short column, Columns with uni-axial and bi-axial bending; Long columns, use of design charts. Design of foundation; Wall footing, Isolated and combined footing for columns. All designs to be as per the most recent BIS standards as applicable Prerequisite:

14. **Design of Concrete Structures-II.** Design of continuous beams and building frames, Moment redistribution, Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, Detailing for earthquake resistant construction – ductility criteria; Water tank and staging; Introduction, Design criteria, Design of rectangular and circular water tank, Design of Intze tank, Staging for overhead tank; Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert; Design of Masonry walls and columns; Pre-stressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders, Design of end block; Design of staircases; Design of cantilever and counter-forte type retaining wall; All design steps/process to as per the most recent BIS code of practices

15. **Reinforced Concrete.** Study of the strength, behavior, and design of reinforced concrete members subjected to moments, shear, and axial forces; extensive discussion of the influence of the material properties on behavior.

16. **Concrete Technology.** Concrete; Properties of ingredients, tests, Production of concrete, mixing, compaction curing, Properties of fresh concrete; Defects in Concrete, Concrete additives.; Behavior of concrete in tension and compression, shear and bond, Influence of various factors on test results, Time dependent behavior of concrete -creep, shrinkage and fatigue; Concrete mix design; Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion, different method of mix design. Quality control, Behavior of concrete in extreme environment; temperature problem in concreting, hot weather, cold weather and under water conditions, Resistance to freezing, sulphate and acid attack, efflorescence, fire resistance; Inspection and testing of concrete-Concrete cracking, types of cracks, causes and remedies Non-destructive tests on concrete; Chemical tests on cement and aggregates; Special concrete; types and specifications, Fibre reinforced and steel Fibre reinforced concrete, Polymer concrete, Use of admixtures; Deterioration of concrete and its prevention Repair and rehabilitation.

17. **Design of Steel Structures.** Properties of materials; loads and stresses, Design of semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member, Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders; Introduction to Plastic analysis; Simple cases of beams and frames; All design steps/process to as per the most recent BIS code of practices Prerequisite:

18. **Metal Structure Behavior- I**. Introduction to the design of metal structures; behavior of members and their connections; and theoretical, experimental, and practical bases for proportioning members and their connections.

19. **Metal Structure Behavior-II.** Metal members under combined loads; connections, welded and bolted; moment- resistant connections; plate girders, conventional behavior, and tension field action.

20. **Structural Mechanics.** Beams under lateral load and thrust; beams on elastic foundations; virtual work and energy principles; principles of solid mechanics, stress and strain in three dimensions;static stability theory; torsion; computational methods.

21. **Advanced Structural Analysis.** Elasticity: Introduction, Components of strain and strain, Hooke's law, Plane stress and plane strain, Equations of equilibrium and compatibility, Boundary conditions, Two dimensional problems in rectangular and polar coordinates, Bending of simple and cantilever beams; Model Analysis: Structural similitude, Direct and indirect model analysis, Model material and model making, Measurement for forces and deformations; Introduction to Finite element method for structural analysis; Review of principle of virtual work, Ritz method, Discretization of domain, Basic element shape, Discretization process; Application of finite element method to one and two- dimensional plane stress strain elements.

22. **Structural Analysis-I.** Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; introduction to the finite element method for plane stress and plane strain.

23. **Structural Analysis-II.**Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Application to simple problems of beams and frames; Flexibility matrix method; Application to simple problems of beams and frames; Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.

24. **Structural Analysis by Matrix Methods.** Analysis of truss and frame structures using flexibility and stiffness methods of matrix analysis; computer applications.

25. **Masonry Structures.** Introduction to analysis, design and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile, flexural, and shear behavior of masonry structural components. Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems.

26. **Civil Engineering Design -I.** Concept of design and its contribution to the quality of life; Civil Engineering Design, the role of geomatics, the environment, and scientific laws in design; Introduction to the design of buildings and Civil Engineering Infrastructure, site appraisal; Risk and vulnerability in design; Health and safety in Civil Engineering Design, environmental impact assessment; Civil Engineering drawing, CAD techniques, introduction to GIS techniques.

27. **Civil Engineering Design-II.**Innovation and creativity in conceptual design; sustainability; health and safety; investigative procedures. The use of analysis, synthesis and optimization in design; project planning, networks and graphs. Design of embankments, dams; drainage design; route location and alignment design of roads; assessment of natural hazard impacts and environmental impacts.

28. **Geographic Information Systems and Science.** Investigation of geographic information systems (GIS) and science (GIScience) including theory and applications areas. A major portion of the course will be based on use of a current widely-used GIS computer software system. Aspects of geographic data entry and editing, spatial analysis, and map development and display will be considered. Relationship of GIS to the Global Positioning System (GPS) and satellite generated data will be addressed.

29. **Modeling and Analysis of Uncertainty.** Appreciation and understanding of uncertainties and the conditions under which they occur, within the context of the engineering problem-solving pedagogy of measurements, models, validation, and analysis. Problems and concerns in obtaining measurements; tabular and graphical organization of data to minimize misinformation and maximize information; and development and evaluation of models. Concepts will be supported with computer demonstration. Applications to problems in engineering are emphasized.

30. **Systems Engineering & Economics:** Introduction to the formulation and solution of civil engineering problems. Major topics are: engineering economy, mathematical modeling, and optimization. Techniques, including classical optimization, linear and nonlinear programming, network theory, critical path methods, simulation, decision theory, and dynamic programming are applied to a variety of civil engineering problems.

Open Elective-II

OEC 401	Metro Systems and Engineering	3L:0T:0P	3 credits

GENERAL: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials

CIVIL ENGINEERING-Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management

ELECTRONICS AND COMMUNICATION ENGINEERING- Signalling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

MECHANICAL & TV + AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

ELECTRICAL: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics

Professional Elective Course- VII

PECCEEL-402	**Geotechnical Engineering**	**3L:0T:0P**	**3 credits**

1. **Soil Mechanics-I.** Composition and structure of soil; water flow and hydraulic properties; stress in soil; compaction and compressibility of soils; consolidation characteristics, settlement analysis; shear strength of soils; basics of unsaturated soils; experimental measurements.

Reference books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning

On successful completion of this course, the students:

- Should be able to assess soil behavior with the mineralogy present and advanced soil testingof soils such as in thermal, chemical, magnetic fields.
- Should be able to do seepage analysis for finding discharge calculation and stability ofstructure.

Should have knowledge about stress paths and get introduced to critical state soilmechanics

- Should be in a position to do various laboratory experiments to determine design parametersaccording field application.

2. **Soil Mechanics-II.** Application of soil mechanics to determine earth pressures, analysis of retaining walls, cuts & excavations and sheet piles, stability of slopes, instrumentation. Prerequisite:

Reference books:

1. Soil Mechanics by Craig R.F., Chapman & Hall
2. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning

On successful completion of this course, the students:

- Should be able design retaining wall subjected to various loads with the knowledge of earthpressure theories.
- Should be able to design sheet pile wall with different methods.
- Should get familiarized with different construction practices for excavation with advantagesand disadvantages of each method.
- Should be able to determine the safety analysis for slopes with different methods proposed inthe syllabus.
- Should get introduced with the commercial softwares for analyzing the stability of slopes andretaining walls.

3. **Geotechnical Design.** Subsurface site evaluation; integrated design of retaining walls, foundations, pavements, and materials for airports, highways, dams, or other facilities. Prerequisite:

Reference books:

1. Analysis and Design of Substructures: Limit State Design by Swami Saran

Upon completion of the course, the student would be:

- Well acquainted with the various investigation specifications as per the infrastructure to be buildon the proposed site.
- knowing about the properties of materials required for the constructing a desired infrastructure
- familiar with design concepts of various foundation systems familiar with design of transportation facilities

4. Structural Geology. Description, classification, and origin of earth structures. Ways in which the continental crust can deform; link scales of structure from the field, outcrops, hand specimen, thin section by integrating analytical techniques with practical examples. Theoretical and meso to microscale analysis of structures developed through a linked series of lectures and practicals; practical 2D strain analysis; 3D strain concepts; incremental strain, kinematics and polyphase deformations; fold construction and classes; fault evolution and section balancing; fault rock microstructures; fault and fold mechanics, current concepts in plate tectonics, cross-section construction techniques, structural interpretation of seismic data, structural styles in different tectonic settings (thrust and fold belts, rifts, strike and slip, gravity tectonics, inversion), structural geology of reservoir units.

Reference books:

1. Ghosh, S.K., Structural Geology: Fundamentals and Modern Developments, Elsevier; First edition

On successful completion of this course the students will be able to:

- Acquire knowledge on the geometry and type of structures present in earth.
- Understand and describe the features formed in rocks when subjected to stress.
- Understand the impact of structural geology to active tectonic settings
- Understand micro and macro scale deformation mechanisms (viz., brittle, ductile).Portray 2D and 3D strain analysis for various deformation behaviours.
- Interpret graphs and models used in structural geology to understand and demonstratepoly phase deformations.

5. **Offshore Engineering.** Introduction to offshore structures, codes of practice, offshore project management, deep water, offshore site investigations, geophysical methods; offshore sediment sampling, in-situ testing, geological aspects; development of design stratigraphies.

6. **Rock Mechanics.** Determination of physical properties of rocks, failure criterion, rock mass classification, stress around mine openings, strain and displacement of the rock mass, rock reinforcement and support, subsidence.

Reference books:

1. Engineering Rock Mechanics: An Introduction to the Principles by J. A. Hudson and J. P.Harrison
2. Rock Mechanics: For Underground Mining by Barry H.G. Brady
3. Fundamentals of Rock Mechanics, 4th Edition, John Conrad Jaeger, Neville G. W. Cook, RobertZimmerman

On successful completion of this course the students will be able to:

- Define the properties (viz., physical, mechanical) of rocks and failure criterion of rock mass.
- Use engineering rock mass classification (RMR, Q-system, RQD)
- Analyse the stress distribution insitu and around an opening in underground structures (viz.,mine openings, tunnels).
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- Determine the relation between strain and displacement components of rock mass.
- Perform field Instrumentation techniques and laboratory studies.
- Understand the fundamentals of ground subsidence.

7. **Foundation Engineering.** Analysis and design of foundations, types of foundations, bearing capacity and settlement of foundations; ground movements due to construction; analysis and design of excavations, retaining walls, cuts & excavations and sheet piles, slopes and underground structures.

Reference books:

1. A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers, New Delhi, 1999.
2. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.
3. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

After successful completion of this course, the students would:

- learn about types and purposes of different foundation systems and structures. Havean exposure to the systematic methods for designing foundations.
- Be able evaluate the feasibility of foundation solutions to different types of soil conditionsconsidering the time effect on soil behaviour.
- have necessary theoretical background for design and construction of foundation systems.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

ELECTRICAL ENGINEERING

B. Tech in Electrical Engineering

Program Educational Objectives (PEOs)

The Department of Electrical Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electrical and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of E&C Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Program outcomes (POs)

Engineering Graduates will be able to:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B.Tech:

- Every semester shall offer a minimum of **12 credits**.
- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. tech Degree Course could vary from a **minimum of 158** credits to a **maximum of 178** credits.
- All courses of study put together would engage the students for a **minimum of 26 periods** or hours of study a week and a **maximum of 30 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
   (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
   (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate‘s proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	**Credit Breakups**	**Credits**	**Percentage**
1	Humanities and Social Sciences including Management courses	12	
2	Basic Science courses	26	
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	20	
4	Professional core courses	52	
5	Professional Elective courses relevant to chosen specialization/branch	18	
6	Open subjects – Electives from other technical and /or emerging subjects	18	
7	Project work, seminar and internship in industry or elsewhere	12	
8	Mandatory Courses	0	
		*158	

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	**Credits**		
	Theory	Practical	Total
1st/2nd	15	5.5	20.5
2nd/1st	12	5.5	17.5
3rd	25	2	27
4th	18	3	21
5th	18	3	21
6th	15	3	18
7th	12	4	16
8th	9	8	17
Total	110	48	158

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
EE : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

Semester wise- course structure
First/Second Semester

S.No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Total Credits
						Sessional Exam			End Exams		
			L	T	P	CA	TA	Total			
1	BSC 101	Physics-I	3	1	0	20	20	40	60	100	4
2	BSC104	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC 104	Workshop/manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	Environmental Studies									0
PRACTICALS											
1	BSC 101P	Physics-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC104 P	Workshop/manufacturing Practices Lab	0	0	4	-	-	40	60	100	2
3	ESC10 1P	Basic Electrical Engineering English Lab	0	0	4	-	-	40	60	100	1
Total											**17.5**

First/Second-Semester

S. No	Course Code	Subject	Period			Evaluation Scheme				Subject Total	Total Credits
						Sessional Exam			End Exam		
			L	T	P	CT	TA	Total			
1	BSC 103	Mathematics –I (Calculus, Ordinary Differential Equations& Complex Variables)	3	1	0	20	20	40	60	100	4
2	BSC104	Chemistry-I	3	1	0	20	20	40	60	100	4
3	ESC102	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC103	Engineering graphics	1	0	0	20	20	40	60	100	1
5	ESC104	Basic Electrical Engineering	2	0	0	20	20	40	60	100	2
		Slot for MC (Environmental Science)	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC104P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC103 P	Engineering graphics Lab	0	0	4	20	20	40	60	100	2
4	ESC104P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1
Total											**20.5**

Third-Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	EE01	Electrical Circuit Analysis	3	1	0	20	20	40	60	100	4
2	EE02	Analog Electronics	3	0	0	20	20	40	60	100	3
3	EE04	Electrical Machines – I	3	0	0	20	20	40	60	100	3
4	EE06	Electromagnetic Fields	3	1	0	20	20	40	60	100	4
5	BSC201	Mathematics -III	3	1	0	20	20	40	60	100	4
6	ESC201	Engineering mechanics	3	1	0	20	20	40	60	100	4
7	HSMC201	Human psychology	3	0	0	20	20	40	60	100	3
PRACTICALS											
1	EE03	Analog Electronics Lab	0	0	2	20	20	40	60	100	1
2	EC05	Electrical Machines – I Lab	0	0	2	20	20	40	60	100	1
Total											**27**

Fourth-Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
THEORY											
1	EE07	Digital Electronics	3	0	0	20	20	40	60	100	3
2	EE09	Electrical Machines – II	3	0	0	20	20	40	60	100	3
3	EE11	Power Electronics	3	0	0	20	20	40	60	100	3
4	EE13	Signals and Systems	2	1	0	20	20	40	60	100	3
5	BSC202	Biology-I	3	0	0	20	20	40	60	100	3
6	HSMC202	Human values	3	0	0	20	20	40	60	100	3
7	MC-02	PYTHON	3	0	2	20	20	40	60	100	0
PRACTICALS											
1	EE08	Digital Electronics Lab	0	0	2	0	0	40	60	100	1
2	EE10	Electrical Machines – II Lab	0	0	2	0	0	40	60	100	1
3	EE12	Power Electronics Lab	0	0	2	0	0	40	60	100	1
Total											**21**

Fifth-Semester

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
THEORY											
1	EE14	Power Systems – I (Apparatus and Modelling)	3	0	0	20	20	40	60	100	3
2	EE16	Control Systems	3	0	0	20	20	40	60	100	3
3	EE18	Microprocessors	3	0	0	20	20	40	60	100	3
4	PEC-EE01	Program Elective – 1	3	0	0	20	20	40	60	100	3
5	OEC-EE 01	Open Elective-1	3	0	0	20	20	40	60	100	3
6	HSMC 501	Management I(OB/F&A*)	3	0	0	20	20	40	60	100	3
7	MC-03	Constitution of India								0	
PRACTICALS											
1	EE15	Power Systems Lab	0	0	2	0	0	40	60	100	1
2	EE17	Control Systems Lab	0	0	2	0	0	40	60	100	1
3	EE19	Microprocessors Lab	0	0	2	0	0	40	60	100	1
Total											**21**

Sixth-Semester

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
THEORY											
1	EE20	Power Systems – II (Operation and Control)	3	0	0	20	20	40	60	100	3
2	EE22	Measurements and Instrumentation	3	0	0	20	20	40	60	100	3
3	PEC-EE02	Program Elective – 2	3	0	0	20	20	40	60	100	3
4	PEC-EE03	Program Elective – 3	3	0	0	20	20	40	60	100	3
5	OEC-EE02	Open Elective-2	3	0	0	20	20	40	60	100	3
PRACTICALS											
1	EE21P	Power Systems – II Lab	0	0	4	-	-	40	60	100	2
2	EE23P	Measurements and Instrumentation Lab	0	0	2	-	-	40	60	100	1
Total											**18**
PROJ EE		Summer Internship	During Summer Vacations / Non-credit								

Seventh Semester

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	PEC-EE04	Program Elective – 4	3	0	0	20	20	40	60	100	3
2	PEC-EE05	Program Elective – 5	3	0	0	20	20	40	60	100	3
3	OEC-EE03	Open Elective-3	3	0	0	20	20	40	60	100	3
4	OEC-EE04	Open Elective-4	3	0	0	20	20	40	60	100	3
PRACTICALS											
1	PROJ-EE01	Project Stage-I	0	0	8	-	-	40	60	100	4
Total											**16**

Eight-Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	PEC-EE06	Program Elective – 6	3	0	0	20	20	40	60	100	3
2	OEC-EE05	Open Elective-5	3	0	0	20	20	40	60	100	3
3	OEC-06	Open Elective-6	3	0	0	20	20	40	60	100	3
PROJECT											
1	PROJ-EE02	Project Stage-II	0	0	16			200	400	600	8
Total											**17**

PROFESSIONAL ELECTIVE COURSES [ELECTRICAL ENGINEERING]

S. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits
1	PEC-EE01	Non-conventional energy systems	3:0:0	3
2	PEC-EE02	Line Commutated and Active Rectifiers	3:0:0	3
3	PEC-EE03	Electrical Drives	3:0:0	3
4	PEC-EE04	Electrical and Hybrid Vehicles	3:0:0	3
5	PEC-EE05	Electrical Machine Design	3:0:0	3
6	PEC-EE06	Power System Protection	3:0:0	3
7	PEC-EE07	HVDC Transmission Systems	3:0:0	3
8	PEC-EE08	Power Quality and FACTS	3:0:0	3
9	PEC-EE09	High Voltage Engineering	3:0:0	3
10	PEC-EE10	Electrical Energy Conservation and Auditing	3:0:0	3
11	PEC-EE11	Industrial Electrical Systems	3:0:0	3
12	PEC-EE12	Power System Dynamics and Control	3:0:0	3
13	PEC-EE13	Digital Control Systems	3:0:0	3
14	PEC-EE14	Digital Signal Processing	3:0:0	3
15	PEC-EE15	Computer Architecture	3:0:0	3
16	PEC-EE16	Electromagnetic Waves	3:0:0	3
17	PEC-EE17	Computational Electromagnetics	3:0:0	3
18	PEC-EE18	Control Systems Design	3:0:0	3
19	PEC-EE19	Advanced Electric Drives	3:0:0	3

Sl. No	Code No.	Subject	Credits
01	OEC-EE01	Electronic Devices	3
02	OEC-EE02	Data Structures and Algorithms	3
03	OEC-EE03	Analog and Digital Communication	3
04	OEC-EE04	Computer Networks	3
05	OEC-EE05	Embedded Systems	3
06	OEC-EE06	VLSI circuits	3
07	OEC-EE07	Image Processing	3
08	OEC-EE08	Wavelet Transforms	3
09	OEC-EE09	Power Plant Engineering	3
10	OEC-EE10	Thermal and Fluid Engineering	3
11	OEC-EE11	Strength of Materials	3
12	OEC-EE12	Fluid Machinery	3
13	OEC-EE13	Automobile Engineering	3
14	OEC-EE14	Electrical Materials	3
15	OEC-EE15	Modern Manufacturing Processes	3
16	OEC-EE16	Internet of Things	3
17	OEC-EE17	Big Data Analysis	3
18	OEC-EE18	Computer architecture	3

DETAILED 4-YEAR CURRICULUM CONTENTS

Undergraduate Degree in Engineering &Technology

BRANCH/COURSE: ELECTRICAL ENGINEERING

SEMESTER-I/II

DETAILED CURRICULUM CONTENTS

Course Code: BSC101 **Course Name:** Mathematics-I
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems
- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:
https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: BSC102 **Course Name:** Chemistry-I
Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.
  - Draw the E or Z isomer of a given alkene / Distinguish between different kinds of isomers or
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, "University chemistry", Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", McGraw- -ill International.
- C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, “Engineering Chemistry” (NPTEL).
- K. P. C. Volhardt and N. E. Schore, “ Organic Chemistry: Structure and Function” Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC101 **Course Name:** English
Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication **(4 lectures)**

(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.

- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECS101 **Course Name:** Programming for Problem Solving
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays
Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function
Functions (including using built in libraries), Parameter passing in functions, call by value,
Passing arrays to functions: idea of call by reference.

Unit 6: Recursion
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure
Structures, Defining structures and Array of Structures.

Unit 8: Pointers
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

(iv) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.

(v) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.

(vi) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS
FIRST SEMESTER

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

   R=1 c=1 sum=2
   R=1 c=2 sum=3
   R=2 c=1 sum =3
   R=2 c=2 sum=4
6. Write a program to print the following pattern

7. Write a program to print the square and cube of any given number.
8.

*****	*	1
*****	**	12
*****	***	123
*****	****	1234
	*****	12345

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
    - Find the length of the string.
    - Concatenate two strings
    - Compare two given strings
    - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers.

7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab

Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr'sMethod.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodiumhydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

SEMESTER-I/II

DETAILED CURRICULUM CONTENTS

Course Code: BSC101 **Course Name:** Physics

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)

Introduction to Quantum mechanics
Wave nature of particles
Time independent and time dependent Schrodinger equation for wave function
Born interpretation
Probability current
Expectation values
Free particle wavefunction and wave packets
Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)

Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator
Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)

Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)

Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

Course Code: BSC104 **Course Name:** Mathematics II

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

Unit 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for *x* and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.

- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC104

Course Name: Workshop/Manufacturing Practices

Course Credit: 5.5

Total Contact Hours: 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1

Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel.

Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III

Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.

Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.

Gas & Spot Welding To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

Module V

Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ESC101 **Course Name:** Basic Electrical Engineering
Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

Unit 1: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, “ Basic Electrical Engineering”, Tata McGraw Hill.
- D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill.

Reference books:

- L. S. Bobrow, “ Fundamentals of Electrical Engineering”, Oxford University Press.
- E. Hughes, “Electrical and Electronics Technology”, Pearson.
- V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: AECC01 **Course Name:** Environmental Science
Course Credit Hour: 2hr **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem
  Physical (energy flow), Biological (food chains, food web, ecological succession) and
  Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological
  pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots

- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

Unit 5: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

Unit 6: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):

The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 ¬
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 ¬
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 ¬
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:

https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS SECOND SEMESTER

Lab Code: BSC101P

Lab Name: Physics Lab

Course Credit Hour: 1.5hr

Total Contact Hour: 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC104P **Lab Name:** Workshop/Manufacturing Practice
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: ESC101P **Lab Name:** Electrical Engineering Lab
Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

PROGRAM CORE COURSES

Course Code: PCC-EE01 **Course Name:** Electrical Circuit Analysis
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

1. Fundamentals of Ohm's law, Kirchhoff's current and voltage laws and its practical implementation
2. Measurement of voltage, current, power and impedance of any circuit
3. Analysis of a given circuit depending on types of elements - DC analysis, Transient analysis and Frequency analysis
4. Measurement of frequency and amplitude of any signal using CRO
5. Designing of circuits (at least proto type models) for a given set of specifications weather in time domain or in frequency domain

Course Description:

This **course** introduces fundamental properties and methods for **analysis** of direct- current (DC) **electric circuits** including components such as resistors, capacitors, inductors, operational amplifiers, switches, and ideal and dependent voltage and current sources.

Course Contents:

Unit 1: Network Theorems

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Unit 2: Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, R- L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit 3: Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit 4: Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit 5: Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyze two port circuit behavior.

Text books:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
3. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.

References books:

1. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Midexam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	- 40%

Course Code: PCC-EE02

Course Name: Analog Electronic Circuits

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

1. To give the idea about fundamental properties of semiconductors.
2. To prepare students to perform the analysis of any Analog electronics circuit.
3. To empower students to understand the design and working of BJT / FET amplifiers, oscillators and Operational Amplifier.
4. To prepare the students for advanced courses in Communication system Circuit Design

Course Description:

This course develops a basic understanding of the fundamentals and principles of analog circuits and electronic devices in electrical and electronic engineering. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system.

Course Contents:

Unit 1: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes clamping and clipping circuits.

Unit 2: BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common- collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit 3: MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans- conductance, high frequency equivalent circuit.

Unit 4: Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit 5: Linear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).

Analog to Digital Conversion.

Unit 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the characteristics of transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Text books:

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.

2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.

References books:

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/102/108102112/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE03P **Course Name:** Analog Electronic Circuits Laboratory
Course Credit: 1 **Total Contact Hour:** 20hr

1. To find the voltage gain of a CE amplifier and to find its frequency response.
2. Design a single stage RC coupled amplifier (BJT and FET).
3. Design a emitter follower circuit using darlington pair.
4. Design a two stage RC coupled amplifier and plot of frequency v/s gain, estimation of Q factor and bandwidth.
5. To design a Class A and Class B amplifier.
6. Design of inverting, non inverting and differential amplifier.
7. Measurement of common mode gain, Differential mode gain, CMRR, Slew Rate.
8. Application of Op-Amp as summing amplifier, Difference Amplifier, Integrator, Differentiator.
9. Oscillator Sinusoidal oscillator (i) Wein bridge (ii) Phase shift (iii) Colpitt's (iv) Hartley.
10. To design and obtain the frequency response of (i) First order low pass Filter,(ii) First order High Pass Filter , Band Pass Filter.
11. To construct a 3-bit R-2-R ladder type D/A converter using op-amp IC 741.

Course Code: PCC-EE04

Course Name: Electrical Machines-I

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

To introduce the fundamentals of dc machines, transformer, 3-phase transformer and special purpose transformer.

Course Description:

This course examines the basic theory, characteristics, construction operation and application of rotating electrical machines.

Course Contents:

Unit 1: Magnetic fields and magnetic circuits

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Unit 2: Electromagnetic force and torque

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Unit 3: DC machines

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit 4: DC machine - motoring and generation

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Unit 5: Transformers

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the concepts of magnetic circuits.
- Understand the operation of dc machines.

- Analyse the differences in operation of different dc machine configurations.
- Analyse single phase and three phase transformers circuits.

Text books:

1. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
2. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

References books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105155/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: *PCC-EE05*

Course Name: *Electrical Machines Laboratory– I*

Course Credit: **1**

Total Contact Hour: 20hr

<u>Course Contents</u>:

Hands-on experiments related to the course contents of EE04.

Course Code: PCC-EE06

Course Name: Electromagnetic Fields

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

To get familiarize with concepts of electrostatic fields, magneto statics. To provide the skills required to understand, develop, and design various engineering applications involving electromagnetic fields.

Course Description:

This course examines electric and magnetic quasi static forms of Maxwell's equations applied to dielectric, conduction, and magnetization boundary value problems.

Course Contents:

Unit 1: Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit 2: Static Electric Field (6 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Unit 3: Conductors, Dielectrics and Capacitance (6 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Unit 4: Static Magnetic Fields (6 Hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Unit 5: Magnetic Forces, Materials and Inductance (6 Hours)

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit 6: Time Varying Fields and Maxwell's Equations (6 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Unit 7: Electromagnetic Waves (6 Hours)

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell's equation in different forms and different media.
- To understand the propagation of EM waves.

Text books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.

References books:

1. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
2. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
3. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/104/108104087/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE07 **Course Name:** Digital Electronics
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
To understand design concept of combinational and sequential digital circuits.
Course Description:
Study of electronic circuits that are used to process and control digital signals. In contrast to analog electronics, where information is represented by a continuously varying voltage, digital signals are represented by two discreet voltages or logic levels.
Course Contents:
Unit 1: Fundamentals of Digital Systems and logic families
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit 2: Combinational Digital Circuits
Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit 3: Sequential circuits and systems
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D-typesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel converter parallel to serial converter, ring counter,sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit 4: A/D and D/A Converters
Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using.
Course Learning Outcomes (CLOs):
At the end of this course students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.

2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105132/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE08 **Course Name:** Digital Electronics Laboratory

Course Credit: 1 **Total Contact Hour:** 20hr

1. Verification of NAND, NOR, Ex-OR,AND & OR Gates.
2. Implementation of half Adder & Full Adder
3. Implementation of half Subtractor & Full Subtractor.
4. Implementation of Demultiplexer / Decoder operation using IC-74138.
5. Implementation of Seven segment display.
6. Implementation of Binary to gray converter.
7. Implementation of Arithmetic algorithms.
8. Implementation of various flip-flops.
9. Implementation of Counters.
10. Implementation of shift register.
11. Verification of Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.

Course Code: PCC-EE09 **Course Name:** Electrical Machines – II
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
To introduce the concept of single phase and three phase AC machines, their construction and performance parameters.

Course Description:
This course examines the basic theory, characteristics, construction operation and application of rotating electrical machines. It includes the study of alternators, synchronous motors, polyphase induction motors and single phase motors.

Course Contents:

Unit 1: Fundamentals of AC machine windings
Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single- turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoid ally distributed winding, winding distribution factor

Unit 2: Pulsating and revolving magnetic fields
Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current
Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit 3: Induction Machines
Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors.
Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Unit 4: Single-phase induction motors
Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Unit 5: Synchronous machines
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.

Text books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery" , McGraw Hill Education, 2013.
2. M. G. Say, " Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, " Electrical Machinery" , Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

References books:

1. A. S. Langsdorf, " Alternating current machines", McGraw Hill Education, 1984.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105131/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE10

Course Name: Electrical Machines Laboratory

Course Credit: 1

Total Contact Hour: 20hr

Hands-on experiments related to the course contents of EE09.

Course Code: PCC-EE11

Course Name: Power Electronics

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

To review the operational aspects of power electronic devices and principle of conversion and control of AC and DC voltages for high power applications.

Course Description:

The course focuses on presenting concepts for conversion, control and monitoring of electric energy using power semiconductor devices.

Course Contents:

Unit 1: Power switching devices

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Unit 2: Thyristor rectifiers

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit 3: DC-DC buck converter

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Unit 4: DC-DC boost converter

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit 5: Single-phase voltage source inverter

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Unit 6: Three-phase voltage source inverter

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the differences between signal level and power level devices.

- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Text books:

1. M. H. Rashid, "Power *electronics: circuits, devices, and applications*", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.

References books:

1. L. Umanand, " Power Electronics: Essentials and Applications" , Wiley India, 2009.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/102/108102145/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE12

Course Name: Power Electronics Laboratory

Course Credit: 1

Total Contact Hour: 20hr

Hands-on experiments related to the course contents of EE11.

Course Code: PCC-EE13

Course Name: Signals and Systems

Course Credit: 3

Total Contact Hour: 40hr

Course Objective: Understanding the fundamental characteristics of signals and systems. Understanding the concepts of vector space, inner product space and orthogonal series.

Course Description:

Signals and Systems is an introduction to analog and digital signal processing, a topic that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defense electronics, consumer electronics, and consumer products.

Course Contents:

Unit 1: Introduction to Signals and Systems

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit 2: Behavior of continuous and discrete-time LTI systems

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit 3: Fourier, Laplace and z- Transforms

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit 4: Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.

Text books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, " Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications" , Pearson, 2006.
3. H. P. Hsu, " Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, " Signals and Systems", John Wiley and Sons, 2007.

References books:

1. A. V. Oppenheim and R. W. Schafer, " Discrete-Time Signal Processing", Prentice Hall, 2009.
2. M. J. Robert " Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
3. B. P. Lathi, " Linear Systems and Signals", Oxford University Press, 2009.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/104/108104100/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE14 **Course Name:** Power Systems-I
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To know the importance of compensation in power system and study the different compensating techniques.
- Study about different transients and their protection those are introduced in power system.

Course Description:

This course is an introductory subject in the field of electric power systems and electrical to mechanical energy conversion. The course material includes: fundamentals of energy-handling electric circuits, power electronic circuits such as inverters, and electromechanical apparatus.

Course Contents:

Unit 1: Basic Concepts

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Unit 2: Power System Components

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power.

Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto- transformers, Neutral Grounding transformers. Tap-Changing in transformers.

Transformer Parameters. Single phase equivalent of three-phase transformers.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions –

steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Unit 3: Over-voltages and Insulation Requirements
Generation of Over-voltages: Lightning and Switching Surges. Protection against Over- voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Unit 4: Fault Analysis and Protection Systems
Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Unit 5: Introduction to DC Transmission & Renewable Energy Systems
DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

Course Learning Outcomes (CLOs):
At the end of this course students will demonstrate the ability to

- Understand the concepts of power systems.
- Understand the various power system components.
- Evaluate fault currents for different types of faults.
- Understand the generation of over-voltages and insulation coordination.
- Understand basicprotection schemes.
- Understand concepts of HVdc power transmission and renewable energy generation.

Text books:

1. J. Grainger and W. D. Stevenson, “Power System Analysis” , McGraw Hill Education, 1994.
2. O. I. Elgerd, “ Electric Energy Systems Theory” , McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “ Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “ Modern Power System Analysis” , McGraw Hill Education, 2003.

References books:

1. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “ Electric Power Systems”, Wiley, 2012.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105104/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE15 **Course Name:** Power Systems – I Laboratory
Course Credit: 1 **Total Contact Hour:** 20hr

Hands-on experiments related to the course contents of EE14. Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro-magnetic transient program (EMTP) and Numerical Relays are suggested.

Course Code: PCC-EE16 **Course Name:** Control Systems
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

• To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis.

• To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system.

Course Description:

Transfer functions; Stability; Dynamic and steady-state performance; Root locus diagrams; Bode plots; Cascade compensation using root locus and frequency response techniques. Introduction to state-space modelling and analysis. Analysis and design of digital control systems.

Course Contents:

Unit 1: Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit 2: Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.

Analog and Digital implementation of controllers.

Unit 5: State variable Analysis

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the modelling of linear-time-invariant systems using transfer function and state-space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Text books:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.

References books:

1. I. J. Nagrath and M. Gopal, “ Control Systems Engineering”, New Age International, 2009

Online links for study & reference materials:

https://nptel.ac.in/courses/107/106/107106081/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE17 **Course Name:** Control Systems Laboratory
Course Credit: 1 **Total Contact Hour:** 20hr

Hands-on/Computer experiments related to the course contents of EE16.

Course Code: PCC-EE18 **Course Name:** Microprocessors
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Course Description:

The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation. Topics include Semiconductor memory devices and systems, microcomputer architecture, assembly language programming, I/O programming, I/O interface design, I/O peripheral devices, data communications, and data acquisition systems.

Course Contents:

Unit 1: Fundamentals of Microprocessors

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Unit 2: The 8051 Architecture

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit 3: Instruction Set and Programming

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Module4: Memory and I/O Interfacing (6 Hours):

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices.

Unit 5: External Communication Interface

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Module6: Applications (06 Hours)

LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Do assembly language programming.
- Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers.

Text books:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning, 2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education, 2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996

References books:

1. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
2. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/107/108107029/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE19 **Course Name:** Microprocessor Laboratory
Course Credit: 1 **Total Contact Hour:** 20hr

Hands-on experiments related to the course contents of EE18.

Course Code: PCC-EE20 **Course Name:** Power Systems – II
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To introduce the students to the general structure of the network for transferring power from generating stations to the consumers.
- To expose the students to the different electrical & mechanical aspects of the power network along with its environmental and safety constraints.

Course Description:

This course will cover fundamentals on power system modeling for the purposes of dynamic studies and stability control, teach the methods for analyzing main stability issues of power systems and introduce the tools for planning and operating a modern interconnected power grid to meet reliability criteria under disturbances. There will be minor programming work in MATLAB or using professional power system software.

Course Contents:

Unit 1: Power Flow Analysis

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Unit 2: Stability Constraints in synchronous grids

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Unit 3: Control of Frequency and Voltage

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.

Power flow control using embedded dc links, phase shifters and

Unit 4: Monitoring and Control

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Unit 5: Power System Economics and Management

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

Text books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.

References books:

1. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105067/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-EE21 **Course Name:** Power Systems-II Laboratory
Course Credit: 1 **Total Contact Hour:** 20hr

Hands-on and computational experiments related to the course contents of EE20. This should include programming of numerical methods for solution of the power flow problem and stability analysis. Visit to load dispatch Centre is suggested.

Course Code: PCC-EE22 **Course Name:** Measurements and Instrumentation Laboratory

Course Credit: 3 **Total Contact Hour:** 40hr

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Design and validate DC and AC bridges.
- Analyze the dynamic response and the calibration of few instruments.
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis.
- Understand computerized data acquisition.

Course Code: PCC-EE23 **Course Name:** Electronics Design Laboratory

Course Credit: 3 **Total Contact Hour:** 40hr

Lectures/Demonstrations:

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the practical issues related to practical implementation of applications using electronic circuits.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.

Text books:

1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.

References books:

1. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

PROFESSIONAL ELECTIVE COURSES

Course Code: PEC-EE01 **Course Name:** Wind and Solar Energy Systems

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Apply engineering techniques to build solar and wind.

Analyze and evaluate the implication of renewable energy.

Concepts in solving numerical problems pertaining to solar radiation geometry and wind energy systems

Course Description:

This course involves the description, theory design and operation of wind and solar energy systems. The energy systems presented are: wind energy, solar PV and solar thermal systems. The theory governing these systems and their working principles are explained.

Course Contents:

Unit 1: Physics of Wind Power

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 2: Wind generator topologies

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3: The Solar Resource

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4: Solar photovoltaic

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit 5: Network Integration Issues

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Module 6: Solar thermal power generation

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Text books:

1. T. Ackermann, "Wind Power in Power Systems" , John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.

References books:

1. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications" , Narosa Publications, 2004.
2. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

Online links for study & reference materials:
https://onlinecourses.nptel.ac.in/noc21_ch11/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE02 **Course Name:** Line-Commutated and Active PWM Rectifiers
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
Analyze controlled rectifier circuits. Understand the operation of line-commutated rectifiers 6 pulse and multi-pulse configurations. Understand the operation of PWM rectifiers operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

Course Description:
Schemes for the improvement of power factor in AC-DC converters. Methods for harmonic reduction in the current waveforms of the converters. Types of filters used to obtain ripple free (dc) output voltage and currents, reducing the harmonics

Course Contents:

Unit 1: Diode rectifiers with passive filtering
Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

Unit 2: Thyristor rectifiers with passive filtering
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

Unit 3: Multi-Pulse converter
Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Unit 4: Single-phase ac-dc single-switch boost converter
Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

Unit 5: Ac-dc bidirectional boost converter
Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Unit 6: Isolated single-phase ac-dc flyback converter
Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control

Course Learning Outcomes (CLOs):
At the end of this course students will demonstrate the ability to

- Analyse controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

Text books:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison- Wesley, 1991.
3. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India, 2009.

References books:

1. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/107/108107128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE03 **Course Name:** Electrical Drives
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
To provide fundamental knowledge in dynamics and control of Electric Drives. To justify the selection of Drives for various applications. To familiarize the various semiconductor controlled drives employing various motors.

Course Description:
The course aims at giving a broad overview of Electrical Drive Systems. It is assumed that the students have prior exposure to Electrical Machines and Power Electronics.

Course Contents:

Unit 1: DC motor characteristics
Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Unit 2: Chopper fed DC drive
Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Unit 3: Multi-quadrant DC drive
Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Unit 4: Closed-loop control of DC Drive
Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Unit 5: Induction motor characteristics
Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Unit 6: Scalar control or constant V/f control of induction motor
Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Unit 7: Control of slip ring induction motor
Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the characteristics of dc motors and induction motors.
- Understand the principles of speed-control of dc motors and induction motors.
- Understand the power electronic converters used for dc motor and induction motor speed control.

Text books:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control” , Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.

References books:

1. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/104/108104140/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE04 **Course Name:** Electrical and Hybrid Vehicles
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1. Understand working of Electric Vehicles and recent trends.
2. Know-how & aptitude towards future trends in Hybrid Electric Vehicles.

Course Description:
This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
Course Contents:
Unit 1: Introduction
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.
Unit 2:
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.
Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit 3: Electric Trains
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive- train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit 4: Energy Storage
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit 5: Energy Management Strategies
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Course Learning Outcomes (CLOs):
At the end of this course students will demonstrate the ability to

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

Text books:

1. C. Mi, M. A. Masrur and D. W. Gao, “ Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “ Hybrid Electric Vehicles: Energy Management Strategies” , Springer, 2015.

References books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

Online links for study & reference materials:
https://nptel.ac.in/courses/108/103/108103009/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment -2	- 05%
Assessment -3 (Mid exam)	- 20%
Assessment -3	- 05%
Assessment -4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE05 **Course Name:** Electrical Machine Design
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

Course Description:
This **course** covers basic **design** principles of **electrical machines**. You will be able to **design** main parameters of an **electric machine** such as magnetic and **electric** loading, number of slots, winding dimensions. Thermal and structural **design** of **electric machines** will be also covered.
Course Contents:
Unit-I Introduction
Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.
Unit-II Transformers
Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, Window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers
Unit-III Induction Motors
Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphone machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit-IV Synchronous Machines
Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.
Unit-V Computer aided Design (CAD)
Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM Based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Course Learning Outcomes (CLOs):
- Design DC machines.
- Design transformers with reduced losses
- Calculate the losses and efficiency in the machines
- Analyze and synthesis of computer aided design of electrical machines.
- Design three phase induction motor

Text books:

1. A.K.Sawhney, "ACourse in Electrical Machine Design", Dhanpat Rai and Sons, v1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing,2006.

Reference books:

1. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.
2. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
3. K. M. V. Murthy, “ ComputerAided Design of Electrical Machines”, B.S. Publications,2008.
4. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine designpackage.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE06 **Course Name:** Power System Protection
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of_wide-area measurements.

Course Description:

This **course** presents the fundamentals of **power system protection** and its application. A very "hands-on" approach is used to teach the concepts. Understanding is then reinforced with real world examples. Interaction is encouraged between participants and the presenters, to underpin the learning **objectives**.

Course Contents:

Unit-I :

Introduction and Components of a Protection System

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Unit-II

Faults and Over-Current Protection

Review of Fault Analysis, Sequence Networks. Introduction to Over current Protection and over current relay co-ordination.

Unit-III

Equipment Protection Schemes

Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

Unit-IV

Digital Protection

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

Unit-V

Modeling and Simulation of Protection Schemes (8 hours)

CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit-VI

System Protection

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Course Learning Outcomes (CLOs) :

- Explain various protection strategies applied for power system protection.
- Select the protection elements namely fuse, circuit breakers and relays for a given configuration.
- Design the basic Earthing requirement for residential and other purposes.
- Select required protection measures against over current, overvoltage in transmission lines.
- Select suitable protection scheme for different power system equipment.

Text books:

1. A. G. Phadke and J. S. Thorp, " Computer Relaying for Power Systems", John Wiley & Sons,1988.
2. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications" , Springer,2008.

Reference books:

3 J. L. Blackburn, " Protective Relaying: Principles and Applications" , Marcel Dekker, New York,1987.

4 A Y. G.Paithankar and S. R. Bhide, " Fundamentals of power system protection" , Prentice Hall, India,2010.

5 D. Reimert, " Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-EE05 **Course Name:** Electrical Machine Design

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

Course Description:

This **course** covers basic **design** principles of **electrical machines**. You will be able to **design** main parameters of an **electric machine** such as magnetic and **electric** loading, number of slots, winding dimensions. Thermal and structural **design** of **electric machines** will be also covered.

Course Contents:

Unit-I Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit-II Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, Window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers

Unit-III Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rule selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Unit-IV Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit-V Computer aided Design (CAD)

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-polemachines.

Course Learning Outcomes (CLOs):

- Design DC machines.
- Design transformers with reduced losses
- Calculate the losses and efficiency in the machines
- Analyze and synthesis of computer aided design of electrical machines.
- Design three phase induction motor

Text books:

4. A.K.Sawhney, “ACourseinElectricalMachineDesign”,Dhanpat Rai and Sons,1970.
5. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBSLondon.

6. S. K. Sen, “Principlesof Electrical Machine Design with computer programmes”, Oxford and IBH Publishing,2006.

Reference books:

5. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.
6. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
7. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
8. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method :(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-07** **Course Name:** HVDC Transmission System
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

 Understand the advantages of dc transmission over ac transmission.
 Understand the operation of Line Commutated Converters and Voltage Source Converters.
 Understand the control strategies used in HVdc transmission system.
 Understand the improvement of power system stability using an HVdc system.

Course Description:

To introduce students with the concept of **HVDC Transmission system**. To familiarize the students with the **HVDC** converters and their control **system**. To expose the students to the harmonics and faults occur in the **system** and their prevention.**Course Contents:**

Unit-I dc Transmission Technology

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems.

Unit-II Analysis of Line Commutated and Voltage Source Converters

Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links.

Unit-III Control of HVdc Converters:

Principles of Link Control in a LCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit-IV Components of HVdc systems:

Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC sys

Unit-V Stability Enhancement using HVdc Control

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

MTdc Links

Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVdcTechnology. Introduction to Modular Multi-level Converters.

Course Learning Outcomes(CLOs) :

- Choose intelligently AC and DC transmission systems for the dedicated application(s).
- Identify the suitable two-level/multilevel configuration for high power converters.
- Select the suitable protection method for various converter faults.
- Identify suitable reactive power compensation method.
- Decide the configuration for harmonic mitigation on both AC and DC sides

Text books/Reference books:

1 K. R. Padiyar, " HVDC Power Transmission Systems", New Age International

Publishers, 2011.
2 .J. Arrillaga, “ High Voltage Direct Current Transmission”, Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, “ Direct Current Transmission”, Vol.1, Wiley-Interscience, 1971.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-08** **Course Name: Power Quality and FACTS**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.

□□Understand the working principles of FACTS devices and their operating characteristics.

□□Understand the basic concepts of power quality.

□□Understand the working principles of devices to improve power quality.

Course Description:

Understanding of the power quality problems. Knowledge about disturbance sources and their influence on the end users. Ability to perform in-situ measurements and practical skills to analyze measuring results. Proposing measures to improve power quality.

Course Contents:

Unit-I Transmission Lines and Series/Shunt Reactive Power Compensation

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit-II Thyristor-based Flexible AC Transmission Controllers (FACTS)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter..

Unit-III Voltage Source Converter based (FACTS) controllers

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit- Application of FACTS

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Unit-V Power Quality Problems in Distribution Systems

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

Course Learning Outcomes(CLOs) :

Reliably identify the sources of various power quality problems.

- Explain about causes of harmonic and its distortion effect.
- Estimate the impact of various power quality problems on appliances.
- Educate the harmful effects of poor power quality and harmonics.
- Decide the compensators and filters to keep the power quality indices within the standards.

Text/References

1. N. G. Hingorani and L. Gyugyi, " Understanding FACTS: Concepts and Technology of

FACTS Systems”, Wiley-IEEE Press, 1999.
2. K. R. Padiyar, “ FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3. T. J. E. Miller, “ Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4. R. C. Dugan, “Electrical Power Systems Quality” , McGraw Hill Education, 2012.
5. G. T. Heydt, “Electric Power Quality” , Stars in a Circle Publications, 1991

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-09** **Course Name: High Voltage Engineering**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.
Course Description:
To introduce the concepts of breakdown in gases, solids, generation and measurement of high voltage and their tests
Course Contents:
Unit- Breakdown in Gases
Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge.
Unit-II Breakdown in liquid and solid Insulating materials
Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.
Unit-III Generation of High Voltages
Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.
Unit- IV Measurements of High Voltages and Currents
Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.
Unit-V Lightning and Switching Over-voltages
Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching overvoltages, Protection against over-voltages, Surge diverters, Surge modifiers.
High Voltage Testing of Electrical Apparatus and High Voltage Laboratories
Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.
Course Learning Outcomes(CLOs) :
Conceptualize the idea of high voltage and safety measures involved.
- Analyse the breakdown mechanism of solids, liquids and gases.
- Analyse and calculate the circuit parameters involved in generation of high voltages.
- Measure direct, alternating and impulse high voltage signals.
- Measure the dielectric loss and partial discharge involved in non-destructive high voltage tests

Text/Reference Books
1. M. S. Naidu and V. Kamaraju, " High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, " High Voltage Engineering" , New Age International Publishers, 2007.
D. V. Razevig (Translated by Dr. M. P. Chourasia), " High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, " High Voltage Engineering Fundamentals",

Newnes Publication, 2000.
5. R. Arora and W. Mosch “ High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PECEE-10 **Course Name: Electrical Energy Conservation and AuditingCourse**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Understand the current energy scenario and importance of energy conservation.
Understand the concepts of energy management.
Understand the methods of improving energy efficiency in different electrical systems.
Understand the concepts of different energy efficient devices.

Course Description:

To impart basic knowledge to the students about current **energy** scenario, **energy conservation**, **audit** and management. To inculcate among the students systematic knowledge and skill about assessing the **energy efficiency**, **energy auditing** and **energy** management.

Course Contents:

Unit- Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit-II Basics of Energy and its various forms

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit-III Energy Management & Audit

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams

Unit- IV Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Unit-V Energy Efficiency in Industrial Systems

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Course Learning Outcomes(CLOs) :

Conceptualize the idea of high voltage and safety measures involved.

- Analyse the breakdown mechanism of solids, liquids and gases.
- Analyse and calculate the circuit parameters involved in generation of high voltages.
- Measure direct, alternating and impulse high voltage signals.
- Measure the dielectric loss and partial discharge involved in non-destructive high voltage tests

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, " Utilization of Electrical Energy and Conservation" , McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PECEE-11 **Course Name: Industrial Electrical Systems**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.

Understand various components of industrial electrical systems.

Analyze and selectthe proper size of various electrical system components.

Course Description:

This **course** contains basics of **electricity**, major **electrical systems** – its design and properties, trouble shooting devises and their operations along with safety engineering.

Course Contents:

Unit- I Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit-II Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit-III Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting

.**Unit- IV Industrial Electrical Systems I**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit- V Industrial Electrical Systems II

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Module 6: Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

.**Course Learning Outcomes(CLOs) :**

- Basics about electrical equipment's in manufacturing
- Application of electrical equipment's in different types of industries
- Types and working of electric traction systems
- Industry oriented consumption of electrical energy
- Basics about Illumination and its types

Text/Reference Books

2. S. L. Uppal and G. C. Garg, " Electrical Wiring, Estimating & Costing", Khanna

publishers, 2008.
3. K. B. Raina, " Electrical Design, Estimating & Costing", New age International, 2007.
4. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
5. Web site for IS Standards.
6. H. Joshi, " Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-12** **Course Name: Power System Dynamics and Control**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and selectthe proper size of various electrical system components.

Course Description:

This **course** first introduces a student to **power** stability problems and the basic concepts of modeling and analysis of dynamical **systems**. Modeling of **power system** components - generators, transmission lines, excitation and prime mover controllers

Course Contents:

Unit- I Introduction to Power System Operations

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Unit-II Analysis of Linear Dynamical System and Numerical Methods

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysisusing Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Unit-III Modeling of Synchronous Machines and Associated Controllers

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors..

Unit- IV Modeling of other Power System Components

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

Unit- V Stability Analysis

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governordroop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools:Transient Stability Programs, Small Signal Analysis Programs.

Enhancing System Stability

Planning Measures. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control..

Course Learning Outcomes(CLOs) :

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Text/Reference Books

- 1. K.R. Padiyar, “ Power System Dynamics, Stability and Control”, B. S. Publications,
- 2002.
- 2. P. Kundur, “ Power System Stability and Control”, McGraw Hill, 1995.
- 3. P. Sauer and M. A. Pai, “ Power System Dynamics and Stability” , Prentice Hall, 1997.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-13** **Course Name: Digital Control Systems**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
Obtain discrete representation of LTI systems.
Analyse stability of open loop and closed loop discrete-time systems.
Design and analyse digital controllers.
Design state feedback and output feedback controllers.

Course Description:
Modeling, analysis and design of **digital control systems**; A/D and D/A conversions; Z-transforms; time and frequency domain representations; stability; and microprocessor-based designs

Course Contents:

Unit- I

Discrete Representation of Continuous Systems

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Unit-II Discrete System Analysis

Z-T ransform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit-III Stability of Discrete Time System

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit- IV State Space Approach for discrete time systems

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit- V Design of Digital Control System

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Module 6: Discrete output feedback control

Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Course Learning Outcomes(CLOs) :

1. develop the mathematical model of the physical systems.
2. analyze the response of the closed and open loop systems.
3. analyze the stability of the closed and open loop systems.
4. design the various kinds of compensator.
5. develop and analyze state space models
6. **Text Books :**

1. K. Ogata, " Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, " Digital Control Engineering", Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, " Digital Control of Dynamic Systems", Addison-Wesley, 1998.
4. B.C. Kuo, " Digital Control System", Holt, Rinehart and Winston, 1980.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-14** **Course Name: Digital Signal Processing**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
Analyse discrete-time systems using z-transform.
Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
Design digital filters for various applications.
Apply digital signal processing for the analysis of real-life signals.

Course Description:

The **course** covers theory and methods for **digital signal processing** including basic principles governing the analysis and design of discrete-time systems as **signal processing** devices. ... DSP is a logical extension of **Signals** and Systems in which we take a comprehensive view of discrete-time systems.

Course Contents:

Unit- I

Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Samplingand reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit-II Z-transform

z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using ztransform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Unit-III Discrete Fourier Transform

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Connvolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit- IV Designof Digital filters

Designof FIR Digital filters: Windowmethod,Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Low-pass, Band-pass, Band- stop and High-pass filters.Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signalprocessing

Unit- V Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes,Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Course Learning Outcomes(CLOs) :

- Explain the digital signal processing concepts and stability analysis of digital system.
- Demonstrate the hardware architecture of DSP Processor.
- Design digital filterand harmonic mitigation.
- Carryout spectrum analysis using DFT.
- Apply DSP concepts for power system purposes such as relaying, protection and metering

Text Books :

1. K. Ogata, " Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, " Digital Control Engineering", Wiley Eastern, 1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, " Digital Control of Dynamic Systems", Addison-Wesley, 1998.
4. B.C. Kuo, " Digital Control System", Holt, Rinehart and Winston, 1980.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PECEE-15 **Course Name:** Computer Architecture
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1. Discuss the basic concepts and structure of computers.
2. Understand concepts of register transfer logic and arithmetic operations.
3. Explain different types of addressing modes and memory organization.
4. Learn the different types of serial communication techniques.
5. Summarize the Instruction execution stages.

Course Description:
This **course** provides students with a solid understanding of fundamental **architectural** techniques used to build today's high-performance processors and systems. **Course** topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors.

Course Contents:

Unit- I

Introduction to computer organization

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization

Unit-II Memory organization

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit-III Input – output Organization

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit- IV 16 and 32 microprocessors

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Unit- V Pipelining

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Different Architectures

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Course Learning Outcomes (CLOs) :

- Understand the concepts of microprocessors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of microprocessors.
- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor.

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
4. W. Stallings, "Computer organization", PHI, 1987.
5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.
6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/
Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PECEE-16 **Course Name:** Electromagnetic waves
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
•To introduce students with different coordinate systems.
•To familiarize the students with the different concepts of electrostatic, magnetostatic and time varying electromagnetic systems.
•To expose the students to the ideas of electromagnetic waves and structure of transmission line

Course Description:
electromagnetic wave theory, emphasizing mathematical approaches, problem solving, and physical interpretation. ... Examples deal with limiting cases of Maxwell's theory and diffraction and scattering of **electromagnetic waves**.

Course Contents:

Unit- I

Transmission Lines

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Unit-II Maxwell's Equations

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwel

Unit-III Uniform Plane Wave

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Unit- IV Plane Waves at Media Interface

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface,
Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Unit- V Waveguides

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode,
Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode,
Analysis of waveguide-general approach, Rectangular waveguides.

Antennas

Radiation parameters of antenna, Potential functions, Solution for potential functions,
Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Course Learning Outcomes (CLOs) :
Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
Provide solution to real life plane wave problems for various boundary conditions.
Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
Understand and analyse radiation by antennas.

Text/Reference Books
1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
5. C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.6

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PECEE-17 **Course Name:** Computational Electromagnetics
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
Eectromagnetics, covering analytical, numerical, and asymptotic techniques for solving complex **electromagnetic** problems. Ability not only to effectively use **electromagnetic** software, but also to understand the foundations of various codes.
Course Description:
Computational techniques for practical applications in **electromagnetic** fields, devices, scattering, propagation, and radiation. ... Most popular **classes** of **computational** EM methods based on differential and integral equations are studied.

Course Contents:

Unit- I

Introduction

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic

Unit-II Analytical Methods

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Unit-III Finite Difference Method (FDM)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Unit- IV Finite Element Method (FEM)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Unit- V Special Topics

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Applications

Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability to

- Understand the basic concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

Text/Reference Books

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-18** **Course Name: Control Systems Design**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
To understand concepts of the mathematical modeling, feedback control and stability analysis in Time and Frequency domains

Course Description:
This **course** is designed to provide a graduate level introductory treatment of the theory and **design** of linear feedback **control systems** from both classical and modern viewpoints, with a strong emphasis on the **design** of performance-oriented controllers under typical practical implementation constraints.

Course Contents:

Unit- I

Design Specifications

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit-II Design of Classical Control System in the time domain

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain.
Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Unit-III Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit- IV Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit- V Control System Design in state space

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer.

Reduced order observer. Separation Principle.
Nonlinearities and its effect on system performance
Various types of non-linearities. Effect of various non-linearities on system performance.
Singular points. Phase plot analysis.

Course Learning Outcomes (CLOs) :

At the end of this course, students will demonstrate the ability to
□Understand various design specifications.
□□Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
□□Design controllers using the state-space approach.

Text and Reference Books:

1. N. Nise, “Control system engineering”, John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, “Control system engineering” , Wiley, 2000.
3. M. Gopal, “Digital Control Engineering”, Wiley Eastern, 1988.
4. K. Ogata, “Modern Control Engineering”, Prentice Hall, 2010.
5. B. C. Kuo, “Automatic Control system”, Prentice Hall, 1995.
6. J. J. D’Azzo and C. H. Houpis, “Linear control system analysis and design (conventional and modern)” , McGraw Hill, 1995.
7. R. T. Stefani and G. H. Hostetter, “Design of feedback Control Systems”, Saunders College Pub, 1994.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PECEE-19** **Course Name: Advanced Electric Drives**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
To impart knowledge about fundamentals of **Electric drives** and control, operational strategies of dc and ac motor **drives** as per different quadrant operations and to discuss Review of **Drive** Concept: Review of introductory concepts of **drives**.
Course Description:
Description A **course** on modeling, analysis and design of **electric drive** systems. ... The modeling, simulation and digital controller will be developed in this **course** to analysis and design **advanced electric drive** systems. Important concepts are illustrated with laboratory experiments.
Course Contents:
Unit- I
Power Converters for AC drives
PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.
Unit-II Induction motor drives
Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).
Unit-III Synchronous motor drives
Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.
Unit- IV Permanent magnet motor drives
Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.
Unit- V Switched reluctance motor drives
Evolution of switched reluctance motors, various topologies for SRM drives, comparison,
Closed loop speed and torque control of SRM.
DSP based motion control
Use of DSPs in motion control, various DSPs available,
Course Learning Outcomes(CLOs) :
At the end of this course, students will demonstrate the ability to
- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

Text / References:

1. B. K. Bose, “ Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “ Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.
3. H. A. Taliyat and S. G. Campbell, “ DSP based Electromechanical Motion Control” , CRC press, 2003.
4. R. Krishnan, “ Permanent Magnet Synchronous and Brushless DC motor Drives” , CRC Press, 2009.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Project/Internship

Course Code: PROJ-EE01 **Course Name: Project Work –I**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

Course Code: PROJ-EE02 **Course Name: Project Work II & Dissertation**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:
The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to providea good training for the student(s) in R&D work and technical leadership. The assignment to normally include:
1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

Course Code: PROJ-EE **Course Name:** Summer Industry Internship
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

Course Code: HSMC 201/301 **Course Name:** Human Psychology

Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- ➢ The student will acquire knowledge of human psychology including workplace environment, Motivation and perception.

Course Description:

- ➢ This course introduces the fundamental of human psychology includes important insights about motivation, leadership, perception and work environment.

Course Contents:

Unit 1: Introduction to Psychology (8 lectures)

Definitions & Scope. Types and branches of psychology Major influence on Psychology- Scientific Management and Human relations -Hawthorne Experiments. Taylor Principles, Implications of Psychology on Modern Industries and behavior

Unit 2: Individual at workplace (8 lectures)

Attention and Perception, Individual at Workplace-Attitude, Motivation and Job satisfaction. Stress management. Leadership and Group dynamics.

Unit 3: Work Environment & Engineering Psychology- (7 lectures)

Engineering psychology: fatigue, Monotony, Boredom. Accidents and Safety. Emotional and social development, Cognitive development. Consumer behavior analysis.

Unit 4: Job Analysis (7 lectures)

Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests. Performance Management: Training & Development, Appraisals.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human psychology.
CLO-2: Inculcate leadership and motivational skills.
CLO-3: To understand consumer behavior and emotional development.
CLO-4: To understand about job recruitment process and interviews methods.

Text books:

(i) Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
(ii) Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.

Reference books:

(i) Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.

(ii) Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **HSMC 201**
Course Name: Human Values
Course Credit Hour: 3Hr
Total Contact Hour: 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.

- Development of commitment and courage to act.

Course Description:

- This course introduces the fundamental of human values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4.Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5.Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

1.Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. 2.Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3.Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4.Understanding the characteristics and activities of 'I' and harmony in 'I'.
5.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Unit 3: Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1.Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

2.Understanding the meaning of Trust; Difference between intention and competence 3.Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. 4.Holistic perception of harmony at all levels of existence.

Unit 5 : Implications of the above Holistic Understanding of Harmony on Professional Ethics

1.Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human values

CLO-2: To understand the importance of self-exploration process
CLO-3: To understand harmony at individual levels
CLO-4: To understand harmony at nature level
CLO-5: Develop professional ethics

Textbooks:

(i) Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
(ii) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:

Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MC-02
Course Name: Python
Course Credit Hour: 3hr
Total Contact Hour: 34hr

Course Objective:

- Master the fundamentals of writing Python programs
- Learn basic Python coding elements such as variables, identifiers and flow control structures.
- Discover how to work with lists and sequence data.
- Write Python functions to facilitate code reuse.

- Work with the Python standard library
- Explore Python's object-oriented features

Course Description:

- This is an introductory course designed for any student interested in using computation to enhance their problem solving abilities. No prior experience in programming is necessary. Students will use their problem solving abilities to implement programs in Python. This course will develop a basic understanding the Python programming language

Course Contents:

UNIT 1

Introduction to Python: - History of python programming language, thrust areas of python, overview of programming in Python, identifiers, variables, Expressions and statements, Operators and Operands, data types, indentation, comments, reading input.

UNIT 2

Control flow Statements:-if statement, if-else statement, if-else-elif control flow statement, nested if statement, the while loops, the for loop, Strings: Creating and storing strings, basic string operations, formatting strings and string operations.

UNIT 3

Functions: Built in functions, function definition and calling the function, default parameters, Lists: Creating list, basic list operations, build in functions used in list, list methods, Dictionaries: Creating dictionaries, built on functions used in dictionaries, dictionary methods.

UNIT 4

Tuples: Creates tuples, basic tuple operations, tuple methods, Sets: set methods, Basics Object –oriented Programming: classes and objects, creating classes and objects in python, classes with multiple objects, class attributes vs. data attributes .

Course Learning Outcomes (CLOs):

At the end of the course students will demonstrate the ability to

- Understand python identifiers, variables, Expressions, statements, Operators, operand and data types.
- Implement Conditionals and Loops for Python Programs.
- Use functions and represent Compound data using Lists, Tuples, Dictionaries and strings.
- Implement basics object –oriented components.

Text books:

- Bill Lubanovic, Introducing Python- Modern Computing in Simple Packages, O‘Reilly Publication.
- Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.

Reference books:

- Guido Van Russom, Fred L. Drake, An Introduction to Python, Network Theory Limited.
- Magnus Lie Hetland, Beginning Python: From Novice To Professional, Pearson Education.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106212/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-05%
Assignment -2	- 05%
Assessment -3(Mid Term-exam)-20%	
Assignment -3	- 05%
Assessment-4/ Quiz	- 05%
Total Internal Assessment	**- 40%**

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

ELECTRONICS & COMMUNICATION ENGINEERING

B. Tech in Electronics and Communication Engineering

Program Educational Objectives (PEOs)

The Department of Electronics and Communication Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of E&C Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Program outcomes (POs)

Engineering Graduates will be able to:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B.Tech. ECE program, graduates will be able to:
PSO1. To identify the engineering problems and develop solutions in the area of communication, signal processing, VLSI and embedded systems.
PSO2. To demonstrate proficiency in utilization of software and hardware tools along with analytical skills to arrive at appropriate solutions
PSO3. Incorporate the socio-responsible electronics and communication engineer with leadership, teamworkskills and exhibit a commitment to the lifelong learning.

Credit Distribution

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 1 Hours Practical(Lab)/week	0.5 credits1 credit

Range of credits:

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honors, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

Course code and definition

Course code	**Definitions**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
MC	Mandatory Course
OE	Open Elective
EC	Program Core
ECEL	Program Elective

Structure of Undergraduate Engineering program:

S.no	Category	Credits
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	26
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	20
4	Professional core courses	51
5	Professional Elective courses relevant to chosen specialization/branch	21
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	14
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	Non-credit
Total		**156**

FIRST SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC103	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC102	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC101	English	2	0	0	20	20	40	60	100	2
4	ESC103	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5		Induction Program									0
1	BSC102P	Chemistry-1 Lab	0	0	3	-	-	40	60	100	1.5
2	ESC103P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	HSMC101P	English Lab	0	0	2	20	20	40	60	100	1
4	ESC102P	Engineering Graphics & Design Lab	1	0	4	-	-	40	60	100	3
Total											**20.5**

SECOND SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC101	Physics	3	1	0	20	20	40	60	100	4
2	BSC104	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
4	AECC01	Environmental Studies (MC)	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC101P	Basic Electrical Engineering Lab	0	0	2	20	20	40	60	100	1
3	ESC104P	Workshop Practices / Manufacturing Processes Lab	1	0	4	20	20	40	60	100	3
Total											**17.5**

THIRD SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credit
						Sessional Exam			End Exams	Sub total	
			L	T	P	CA	TA	Total			
1	EC01	Electronic Devices	3	0	0	20	20	40	60	100	3
2	EC03	Digital System Design	3	0	0	20	20	40	60	100	3
3	EC05	Signals & Systems	3	0	0	20	20	40	60	100	3
4	EC06	Network Theory	3	0	0	20	20	40	60	100	3
5	BSC201	Mathematics -III	3	1	0	20	20	40	60	100	4
6	ESC201	Engineering Mechanics	3	1	0	20	20	40	60	100	4
7	HSMC201	Human Psychology	3	0	0	20	20	40	60	100	3
8		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC02	Electronic Devices Lab	0	0	2	20	20	40	60	100	1
2	EC04	Digital System Design Lab	0	0	2	20	20	40	60	100	1
Total											**25**

FORTH SEMESTER											
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**ESE**	**Sub Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
THEORY											
1	EC07	Analog and Digital Communication	3	0	0	20	20	40	60	100	3
2	EC09	Analog Electronics	3	0	0	20	20	40	60	100	3
3	EC11	Microcontrollers	3	0	0	20	20	40	60	100	3
4	BSC202	Biology-I	3	0	0	20	20	40	60	100	3
5	HSMC202	Human values	3	0	0	20	20	40	60	100	3
6	MC02	Python	3	0	2	20	20	40	60	100	0
7		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC08	Analog and Digital Communication Lab	0	0	2	0	0	40	60	100	1
2	EC10	Analog Electronics lab	0	0	2	0	0	40	60	100	1
3	EC12	Microcontrollers Lab	0	0	2	0	0	40	60	100	1
Total											**18**

FIFTH SEMESTER											
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**End Exams**	**Subject Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
THEORY											
1	EC13	Electronic Measurements and Instruments	3	0	0	20	20	40	60	100	3
2	EC15	Computer Architecture	3	0	0	20	20	40	60	100	3
3	EC16	Probability Theory and Stochastic Processes	3	0	0	20	20	40	60	100	3
4	EC17	Digital Signal Processing	3	0	0	20	20	40	60	100	3
5	ECEL*	Program Elective – 1	3	0	0	20	20	40	60	100	3
6	HSMC 501	Management-I (Organizational Behavior)	3	0	0	20	20	40	60	100	3
7		Online courses, NPTEL for Honors degree									
PRACTICALS											
1	EC14	Electronic Measurements & Instrument s Lab	0	0	2	0	0	40	60	100	1
2	EC18	Digital Signal Processing Lab	0	0	2	0	0	40	60	100	1
Total											**20**

SIXTH SEMESTER												
S. No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**						**Total Credits**
						Sessional Exam			**End Exams**	**Subject Total**		
			L	**T**	**P**	**CA**	**TA**	**Total**				
THEORY												
1	EC19	Control Systems	3	0	0	20	20	40	60	100		3
2	EC20	Computer Network	3	0	0	20	20	40	60	100		3
3	ECEL*	Program Elective – 2	3	0	0	20	20	40	60	100		3
4	ECEL*	Program Elective – 3	3	0	0	20	20	40	60	100		3
5		Open Elective-1	3	0	0	20	20	40	60	100		3
6	MC02	Constitution of India	3	0	0	20	20	40	60	100		0
7		Online courses, NPTEL for Honors degree										
PRACTICALS												
1	EC21	Computer Networks Lab	0	0	4	-	-	40	60	100		2
2	EC22	Control Systems Lab	0	0	2	-	-	40	60	100		1
2	EC23	Mini Project/Electronic Design workshop	0	0	4	-	-	40	60	100		2
Total												**20**

SEVENTH SEMESTER

S. No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			End Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	ECEL*	Program Elective – 4	3	0	0	20	20	40	60	100	3
2	ECEL*	Program Elective – 5	3	0	0	20	20	40	60	100	3
3	ECEL*	Program Elective – 6	3	0	0	20	20	40	60	100	3
4		Open Elective-2	3	0	0	20	20	40	60	100	3
5		Online Course, NPTEL for Honors degree									
PRACTICALS											
1	ECP1	Project Stage-I	0	0	10	-	-	40	60	100	5
Total											**17**

EIGTHTH SEMESTER											
S.No	**Course Code**	**Subject**	**Period**			**Evaluation Scheme**					**Total Credits**
						Sessional Exam			**External Exam**	**Subject Total**	
			L	**T**	**P**	**CA**	**TA**	**Total**			
1	ECEL*	Program Elective –7	3	0	0	20	20	40	60	100	3
2		Open Elective-3	3	0	0	20	20	40	60	100	3
3		Open Elective-4	3	0	0	20	20	40	60	100	3
4		Online Course, NPTEL for Honors									
PROJECT											
1	ECP2	Project Stage-II	0	0	18			200	400	600	9
Total											**18**
Total Credits ---- 156											

Program Elective Courses:

S.N	Course Code	Course Title	Preferred Semester
1	ECEL1	Bio-Medical Electronics	V
2	ECEL2	CMOS Design	V
3	ECEL3	Information Theory and Coding	V
4	ECEL4	Introduction to MEMS	VI
5	ECEL5	Electro Magnetic Waves	VI
6	ECEL6	Speech and Audio Processing	VI
7	ECEL7	Power Electronics	VI
8	ECEL8	Nano electronics	VI
9	ECEL9	Scientific computing	VI
10	ECEL10	Adaptive Signal Processing	VII
11	ECEL11	Antennas and Propagation	VII
12	ECEL12	Digital Image & Video Processing	VII
13	ECEL13	Mobile Communication and Networks	VII
14	ECEL14	Mixed Signal Design	VII
15	ECEL15	Microwave Theory and Techniques	VII
16	ECEL16	Fiber Optic Communications	VII
17	ECEL 17	RADAR and Satellite Communication	VII
18	ECEL18	High Speed Electronics	VII
19	ECEL19	Wavelets	VII
20	ECEL20	Wireless Sensor Networks	VIII
21	ECEL21	Embedded systems	VIII
22	ECEL22	Error correcting codes	VIII

OPEN ELECTIVES

1. Non-Conventional Energy Resources(7th)
2. Quality Management (6th)
3. Operations Research
4. Introduction to Biotechnology
5. Nonlinear Dynamic Systems
6. Product Development
7. Automation & Robotics
8. Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)
9. Nano Sciences
10. Laser Systems and Applications
11. Space Sciences
12. Polymer Science & Technology
13. Nuclear Science
14. Material Science
15. Finance & Accounting
16. Human Resource Development (7th)
17. Cyber Law & Ethics (8th)
18. Introduction to Philosophical Thoughts
19. Comparative Study of Literature
20. Indian Music System
21. History of Science & Engineering
22. Introduction to Art and Aesthetics
23. Economic Policies in India
24. Entrepreneurship Development(8th)

DETAILED CURRICULUM CONTENTS

Undergraduate Degree

In

Engineering & Technology

BRANCH: Electronics & Communication Engineering

SEMESTER -1

Course Code: BSC103 **Course Name:** Mathematics-I
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle‘s Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)
Rolle‘s Theorem, Mean value theorems, Taylor‘s and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval‘s theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)
Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)
Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems

- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:
https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000
Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%

Total Internal Assessment - 40%

Course Code: BSC102

Course Name: Chemistry-I

Course Credit Hour: 4hr

Total Contact Hour: 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.
- The properties of a compound are not only determined by the functional groups that it contains,
- but also by the spatial arrangements of the atoms in the molecule. Stereochemistry is the
- branch of chemistry that is concerned with the three-dimensional structures of molecules.

- After studying this unit I should be able to:

    - Distinguish between different kinds of isomers
    - Assign cis/trans or E/Z configuration to an alkene
    - Draw the E or Z-isomer of a given alkene rs or
- diastereomer
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, ―University chemistry‖, Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, ―Chemistry: Principles and Applications‖, McGraw- -ill International.
- C. N. Banwell, ―Fundamentals of Molecular Spectroscopy‖, McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, ―Engineering Chemistry‖ (NPTEL).
- K. P. C. Volhardt and N. E. Schore, ― Organic Chemistry: Structure and Function‖ Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC101
Course Name: English
Course Credit Hour: 2 Hr
Total Contact Hours: 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)
Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication **(4 lectures)**
(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.
- CLO-4: Understand technical writing skills.

- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECS103 **Course Name:** Programming for Problem Solving
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays
Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 6: Recursion
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure
Structures, Defining structures and Array of Structures.

Unit 8: Pointers
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.

- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

(iv) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
(v) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
(vi) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Lab Code: ESC103P **Lab Name:** Programming for Problem Solving
Course Credit Hour: 2hr **Total Contact Hour:** 04
List of Experiments:
Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

```
R=1 c=1 sum=2
R=1  c=2  sum=3
R=2 c=1 sum =3
R=2 c=2 sum=4
```

6. Write a program to print the following pattern

```
*****     *         1
*****     **        12
*****     ***       123
*****     ****      1234
          *****     12345
```

7. Write a program to print the square and cube of any given number.

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
   - Find the length of the string.
   - Concatenate two strings
   - Compare two given strings
   - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers.
7. Write a program to store n elements in an array and print all elements using pointer.

8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Course Code: ESC104 **Course Name:** Workshop/Manufacturing Practices
Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1

Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel.

Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III

Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.

Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.

Gas & Spot Welding To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation
on G.I. Sheet.

Module V

Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, ―Manufacturing Engineering and Technology‖, 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, ―Manufacturing Technology – I‖ Pearson Education, 2008.
- Roy A. Lindberg, ―Processes and Materials of Manufacture‖, 4th edition, Prentice Hall India, 1998.
- Rao P.N., ―Manufacturing Technology‖, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Lab Code: ESC104P **Lab Name:** Workshop/Manufacturing Practice
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: BSC102P **Lab Name:** Chemistry Lab

Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr‘sMethod.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodiumhydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

SEMESTER -2

Course Code: BSC101 **Course Name:** Physics
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)
Introduction to Quantum mechanics
Wave nature of particles
Time independent and time dependent Schrodinger equation for wave function
Born interpretation
Probability current
Expectation values
Free particle wavefunction and wave packets
Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)
Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)
Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator
Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)
Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)
Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

Course Code: BSC104 **Course Name:** Mathematics II
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

Unit 1: Multivariable Calculus (Integration): (10 lectures)
Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)
Exact, linear and Bernoulli‘s equations, Euler‘s equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for *x* and Clairaut‘s type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)
Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)
Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville‘s theorem and Maximum-Modulus theorem (without proof); Taylor‘s series, zeros of analytic functions, singularities, Laurent‘s series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.

- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.
- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC101 **Course Name:** Basic Electrical Engineering
Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

Unit 1: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, ― Basic Electrical Engineering‖, Tata McGraw Hill.
- D. C. Kulshreshtha, ―Basic Electrical Engineering‖, McGraw Hill.

Reference books:

- L. S. Bobrow, ― Fundamentals of Electrical Engineering‖, Oxford University Press.
- E. Hughes, ―Electrical and Electronics Technology‖, Pearson.
- V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: AECC01 **Course Name:** Environmental Science
Course Credit Hour: 2hr **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem Physical (energy flow), Biological (food chains, food web, ecological succession) and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example

- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

Unit 5: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

Unit 6: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India‘s National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):
The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 ¬
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 ¬
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 ¬
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:
https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Lab Code: BSC101P **Lab Name:** Physics Lab
Course Credit Hour: 1.5hr **Total Contact Hour:** 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC101P **Lab Name:** Electrical Engineering Lab
Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

SEMESTER -3

Course Code: EC01 **Course Name: Electronic Devices**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand basic semiconductor properties and hence improvement in future design consideration.
- To analyze different types of current in semiconductor.
- To understand characteristics of Transistor and MOS and other devices.
- To have an understanding of Integrated circuit fabrication process.

Course Description:

This course explores the theory and principles of electronic devices. Special attention is devoted to topics Semiconductor Physics, Generation and recombination, Bipolar Junction Transistor, MOS transistor, Integrated circuit fabrication process.

Course Contents:

UNIT 1

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

UNIT 2

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

UNIT 3

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

UNIT 4

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the principles of semiconductor Physics
- Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

Text books:

- G. Streetman, and S. K. Banerjee, ―Solid State Electronic Devices,‖ 7th edition, Pearson,2014.
- D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.

Reference books:

- S. M. Sze and K. N. Kwok, ―Physics of Semiconductor Devices,‖ 3rd edition, John Wiley &Sons, 2006.
- C.T. Sah, ―Fundamentals of solid state electronics,‖ World Scientific Publishing Co. Inc, 1991.
- Y. Tsividis and M. Colin, ‒Operation and Modeling of the MOS Transistor,‖ Oxford Univ.Press, 2011.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/103/117103063/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC03 **Course Name:** Digital System Design

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems.

Course Description:

This course emphasizes on the fundamental of digital electronics. The student is first taught about the number system and logic gates before introducing them to digital IC technology. Then they are exposed to both combinational logic network and combinational MSI logic. In concurrence with this, the fundamental of sequential logic, flip-flop, counter and shift register will be taught. The memory devices are introduced. Finally the use of HDL is briefed.

Course Contents:

Unit 1

Logic Simplification: Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Unit 2

Combinational Logic Design: MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Unit 3

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Unit 4

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

Unit 5

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.

- Use HDL & appropriate EDA tools for digital logic design and simulation
- Be able to use PLDs to implement the given logical problem.

Text books:

- Moris Mano, ‒Digital Logic and Computer Design‖, PHI Publications, 2002
- R. P. Jain, ―Modern Digital Electronics‖, TMH, 3rd Edition, 2003.

Reference books:

- Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
- R.L. Tokheim, ‒Digital Electronics, Principles and Applications‖, Tata McGraw Hill, 1999.
- W. Gothman, ‒Digital electronics‖, PHI.
- S. Salivahanan & S. Arivyhgan. ‒Digital circuits and design‖, Vikas Publication, 2001
- Malvino Leach, "Digital Principles and Application", TMH, 1999.
- V. Rajaraman : Computer Fundamentals (PHI)

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC05 **Course Name: Signals and System**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understanding the fundamental characteristics of signals and systems.
- Understanding the concepts of vector space, inner product space and orthogonal series.
- Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Description:
This course covers the fundamentals of signal and system analysis, focusing on representations of discrete-time and continuous-time signals (singularity functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transforms, sampling) and representations of linear, time-invariant systems (difference and differential equations, block diagrams, system functions, poles and zeros, convolution, impulse and step responses, frequency responses). Applications are drawn broadly from engineering and physics, including feedback and control, communications, and signal processing.

Course Content:-
Unit 1
Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.
Unit 2
Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations. Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response,
Unit 3
Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The idea of signal space and orthogonal bases,
Unit 4
The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.
Unit 5
The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.
Unit 6
State-space analysis and multi- input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals.

Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Course Learning Outcomes(CLO):-

At the end of this course students will demonstrate the ability to

- CO1: Apply the knowledge of linear algebra topics like vector space, basis, dimension, inner product, norm and orthogonal basis to signals.
- CO2: Analyse the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
- CO3: Classify systems based on their properties and determine the response of LSI system using convolution.
- CO4: Analyze system properties based on impulse response and Fourier analysis.
- CO5: Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
- CO6: Understand the process of sampling and the effects of under sampling.

Text books:

- A.Anand Kumar, "Signals and Systems", Second edition, PHI Learning Private Limited,2012.
- A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

Reference books:

- R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
- B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
- Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
- Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
- Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
- M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
- J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC06 **Course Name:** Network Theory
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.
- To analyze circuits in time and frequency domain.
- To explain concepts of driving point and transfer functions, poles and zeroes of network functions and their stability.

Course Description:

The course begins with description of circuit elements & sources. Understanding of various interesting network theorems applied to solve linear, time invariant network problems efficiently in time and s-domain is discussed. Steady and transient solution of network problems with various sources including impulse source, representing a circuit in s-domain (Laplace domain).

Course Contents:

UNIT 1

Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin‘s, Norton‘s, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits. Trigonometric and exponential

UNIT 2

Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

UNIT 3

Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

UNIT 4

Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits,

UNIT 5

Introduction to band pass, low pass, high pass and band reject filters.

Course Learning Outcomes (CLOs):

- At the Understand basics electrical circuits with nodal and mesh analysis.
- Appreciate electrical network theorems.
- Apply Laplace Transform for steady state and transient analysis.
- Determine different network functions.

Text books:

- Van, Valkenburg.; ‒Network analysis‖ ; Prentice hall of India, 2000
- Sudhakar, A., Shyammohan, S. P.‒Circuits and Network‖; Tata McGraw-Hill New Delhi, 1994

Reference books:

- A William Hayt, –Engineering Circuit Analysis‖ 8th Edition, McGraw-Hill Education

Online links for study & reference materials:
https://nptel.ac.in/courses/108/105/108105159/#

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BSC201 **Course Name:** Mathematics-III

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The main objective of this course is to provide students with the probabilistic and statistical analysis mostly used in varied applications in engineering and sciences and it provide the methods of organising and simplifying data so that their significance is comprehensible.

Course Description:

This course provides an introduction to probability and statistics with applications. Topics include: random variables, continuous and bivariate probability distributions, Bayesian inference, hypothesis testing, confidence intervals, curve fitting and regression.

Course Contents:

Unit 1: Basic Probability (12 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions (4 hours)

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions (4 hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 4: Basic Statistics (8 hours)

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics (8 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small samples (4 hours)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Course Learning Outcomes (CLOs):

- CLO-1: Recognize basic probability theory and its application.
- CLO-2: calculate Continuous Probability Distributions and their properties.
- CLO-3: Calculate bivariate distributions and their properties with applications.
- CLO-4: Basic concept of Statistics, Probability distribution and correlation.
- CLO-5: Fitting the data and large sample testing.
- CLO-6: Testing the hypothesis for Small samples

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
- S. Ross, ―A First Course in Probability‖, Pearson Education India,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- W. Feller, ―An Introduction to Probability Theory and its Applications‖, Wiley,

Online links for study & reference materials:

https://nptel.ac.in/courses/111/105/111105041/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC201 **Course Name:** Engineering Mechanics
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies
- To learn the effect of friction on equilibrium.
- To learn kinematics, kinetics of particle and rigid body, related principles.
- To implement the above know how to solve practical problems.

Course Description:

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses you have taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving.

Course Contents:

Unit 1

Force Vectors: Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton‘s laws and its completeness in describing particle motion; Form invariance of Newton‘s Second Law; Solving Newton‘s equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

Unit 2

Force System Resultant: Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application.

Unit 3

Oscillation and Resonance: Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Unit 4

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler‘s laws of motion, their independence from Newton‘s laws, and their necessity in describing rigid body motion; Examples.

Unit 5

Moment of Inertia: Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Analyze and solve the practical problems of statics and dynamics.
- Take up the subjects like TOM, SOM, Design of machine elements, DOS, TOS etc.

Text books:

- Hibbeler, R.C., "Engineering Mechanics: statics", 12th edition, and Prentice Hall
- Beer, F.P. and Johnston, E.R. (2007) ―Vector Mechanics for Engineers (Statics)‖, McGraw-Hill.

Reference books:

- MK Harbola ―Engineering Mechanics‖, 2nd ed.
- MK Verma ―Introduction to Mechanics‖
- D Kleppner & R Kolenkow An Introduction to Mechanics, 2001
- JL Synge & BA Griffiths ―Principles of Mechanics‖ TMH, 1999.
- JL Meriam ―Engineering Mechanics – Dynamics‖, 7th ed.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 201/301 **Course Name:** Human Psychology
Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- The student will acquire knowledge of human psychology including workplace environment, Motivation and perception.

Course Description:

- This course introduces the fundamental of human psychology includes important insights about motivation, leadership, perception and work environment.

Course Contents:

Unit 1: Introduction to Psychology (8 lectures)

Definitions & Scope. Types and branches of psychology Major influence on Psychology- Scientific Management and Human relations -Hawthorne Experiments. Taylor Principles, Implications of Psychology on Modern Industries and behavior

Unit 2: Individual at workplace (8 lectures)

Attention and Perception, Individual at Workplace-Attitude, Motivation and Job satisfaction. Stress management. Leadership and Group dynamics.

Unit 3: Work Environment & Engineering Psychology- (7 lectures)

Engineering psychology: fatigue, Monotony, Boredom. Accidents and Safety. Emotional and social development, Cognitive development. Consumer behavior analysis.

Unit 4: Job Analysis (7 lectures)

Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests. Performance Management: Training & Development, Appraisals.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human psychology.
CLO-2: Inculcate leadership and motivational skills.
CLO-3: To understand consumer behavior and emotional development.
CLO-4: To understand about job recruitment process and interviews methods.

Text books:

(i) Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
(ii) Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.

Reference books:

(i) Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.
(ii) Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Electronic Devices Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC02**

Credits:1

1. To plot the V-I characteristics of junction tunnel & Schotky diode.
2. To plot the characteristics of P-N junction diode
3. To plot the C-V characteristics of P-N junction diode
4. To plot the halfwave & fullwave rectifier.
5. To plot the V-I Characteristics of zener diode.
6. To Study of zener diode as a voltage regulator.
7. To plot the input output characteristics of BJT in CB, CC, CE configuration.
8. To plot the input output characteristics of FET in CS Configuration.
9. To plot the optical (V-I) Characteristics of Photodiode.
10. To study the depletion mode & Enhancement mode MOSFET.

Digital System Design Lab

Teaching Scheme:- 0L: 0T: 2P **Paper Code: EC04**
Credits:1

1. Verification of NAND, NOR, Ex-OR,AND & OR Gates.
2. Implementation of half Adder & Full Adder
3. Implementation of half Subtractor & Full Subtractor.
4. Implementation of Demultiplexer / Decoder operation using IC-74138.
5. Implementation of Seven segment display.
6. Implementation of Binary to gray converter.
7. Implementation of Arithmetic algorithms.
8. Implementation of various flip-flops.
9. Implementation of Counters.
10. Implementation of shift register.
11. Verification of Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.

SEMESTER -4

Course Code:EC07 **Course Name:** Analog and Digital Communication
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand basic elements of a communication system
- To conduct analysis of baseband signals in time domain and in frequency domain
- To demonstrate understanding of various analog and digital modulation and demodulation techniques techniques.
- To analyse the performance of modulation and demodulation techniques in various transmission environments

Course Description:

This course provides a thorough introduction to the basic principles and techniques used in analog and digital communications. The course will introduce analog and digital modulation techniques, communication receiver and transmitter design, baseband and bandpass communication techniques, line coding techniques, noise analysis, and multiplexing techniques. The course also introduces analytical techniques to evaluate the performance of communication systems.

Course Contents:

Unit 1

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit 2

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De-emphasis, Threshold effect in angle modulation.

Unit 3

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit 4

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion, Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit 5

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels-Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Analyze and compare different analog modulation schemes for their efficiency and bandwidth
- Analyze the behavior of a communication system in presence of noise
- Investigate pulsed modulation system and analyze their system performance
- Analyze different digital modulation schemes and can compute the bit error performance

Text books:

- Haykin S., "Communications Systems", John Wiley and Sons, 2001.
- Proakis J. G. and Salehi M.,"Communication Systems Engineering", Pearson Education, 2002.

Reference books:

- Taub H. and Schilling D.L., "Principles of Communication Systems‖, Tata McGraw Hill, 2001.
- Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
- Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
- Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/102/117102059/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code:EC09 **Course Name:** Analog Electronics
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To Understand the characteristics of diodes and transistors
- Design and analyze various rectifier and amplifier circuits
- Design sinusoidal and non-sinusoidal oscillators
- Understand the functioning of OP-AMP and design OP-AMP based circuits
- Design ADC and DAC

Course Description:

This **course** develops a basic understanding of the fundamentals and principles of **analog circuits** and **electronic** devices in electrical and **electronic** engineering. This understanding is a critical step towards being able to design new **electronic circuits** or use them appropriately as part of a larger engineering system.

Course Contents:

Unit 1

Amplifier models: Voltage amplifier, current amplifier, trans- conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Unit 2

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Unit 3

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

Unit 4

OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Unit 5

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Know about the multistage amplifier using BJT and FET in various configuration to determine frequency response and concept of voltage gain.
- Know about different power amplifier circuits, their design and use in electronics and communication circuits.
- Know the concept of feedback amplifier and their characteristics.
- Design the different oscillator circuits for various frequencies

Text books:

- J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV**.**

Reference books:

- J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
- P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
- Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102112/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC11 **Course Name: Microcontrollers**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

The objectives of the course are to make the students,

- Know the internal organization, addressing modes and instruction sets of 8085 & 8086 processor.
- Know the various functional units of 8051 microcontroller.
- Understand assembly language program by using 8051 Instruction sets and addressing modes.
- Know the various peripheral devices such as 8255, 8279, 8251, 8253, 8259, stepper motor etc.
- Know the various advance microcontroller like ARM processor etc.
- Understand microcontroller based system design for various applications.

Course Description:

The purpose of this course is to teach students the fundamentals of microprocessor and microcontroller systems. The student will be able to incorporate these concepts into their electronic designs for other courses where control can be achieved via a microprocessor/controller implementation. Topics include Semiconductor memory devices and systems, microcomputer architecture, assembly language programming, I/O programming, I/O interface design, I/O peripheral devices, data communications, and data acquisition systems. Several laboratory exercises will be based on both microprocessor (Intel 8086), microcontroller (Intel 8051) and ARM (nuvoTon- Nu-LB-LUC140).

Course Content:

Unit 1

Overview of microcomputer systems and their building blocks, 8085 and 8086 microprocessor, instruction sets of microprocessors.

Unit 2

Memory interfacing, concepts of interrupts and Direct Memory Access, Interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters.

Unit 3

Arithmetic Coprocessors; System level interfacing design, Concepts of virtual memory, Cache memory,

Unit 4

Advanced coprocessor Architectures- 286, 486, Pentium

Unit 5

Microcontrollers: 8051 systems, Introduction to RISC processors; ARM microcontrollers interface designs.

Course Learning Outcomes:

At the end of this course students will demonstrate the ability to

- CO1:- Describe the functionalities of 8085 architectures and Assembly language programming Describe the functionalities of 8086 architectures and Assembly language programming
- CO2:- Describe the architecture and functional block of 8051 microcontroller.

- CO3:- Program the functional units of 8051 microcontroller for the given specifications using C/Assembly language.
- CO4:- Describe various peripheral devices such as 8255, 8279, 8251, 8253, 8259 and 8237.
- CO5:-Explain various applications using 8051 microcontroller and basic architectures of PIC, ARM and ATMEGA microprocessors and microcontrollers.

Text Books:

- Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing.
- Muhammad Ali Mazidi , Janice Gillispie Mazidi and Rolin D McKinlay, The 8051 microcontroller and embedded systems using assembly and C, second edition Pearson education Asia.
- Mohamed Rafiquzzaman, Microprocessor and Microcomputer based system design, second edition, CRC press

Reference Books:

- Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, third Edition, Penram International Publishers.
- A.K Ray & K.M. Burchandi, Advanced Microprocessor and peripherals Architectures, Programming and interfacing –, second edition, Tata McGraw-Hill .
- Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.

Online links for study & reference materials :

https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0

https://www.youtube.com/watch?v=95uGOJ1Ud2c&list=PLJGA4olwzpArvcdWULcRuMn2495g0n8j

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BSC202 **Course Name:** Biology (Biology for Engineers)
Course Credit: 3 **Total Contact Hour:** 33hr

Course Objective:

- To increase the understanding of living systems.
- To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
- To understand the Hierarchy of life forms at phenomenological level.
- To convey that ―Genetics is to biology what Newton‗s laws are to Physical Sciences‖ Mendel‗s laws, Concept of segregation and independent assortment.
- To learn the systems in relationship to the self and other organisms in the natural environment.
- To analyze biological processes at the reductionistic level Proteins- structure and function.
- To know and learn the fundamental principles of energy transactions.

Course Description:

This course explains the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal and population levels of the biological hierarchy.

Course Content:

Unit 1. *(2 hours)- Introduction*

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Unit 2. *(3 hours)- Classification*

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. *E. coli*, *S. cerevisiae*, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.

Unit 3. *(4 hours)-Genetics*

Purpose: To convey that ―Genetics is to biology what Newton's laws are to Physical Sciences‖ Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Unit 4. *(4 hours)-Biomolecules*
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Unit 5. *(4 Hours). Enzymes*
Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Unit 6. *(4 hours)- Information Transfer*
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Unit 7. *(5 hours). Macromolecular analysis*
Purpose: How to analyses biological processes at the reductionistic level Proteins-structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Unit 8. *(4 hours)- Metabolism*
Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Unit 9. *(3 hours)- Microbiology*
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Course Learning Outcomes (CLOs):

At the end of this course students will learn:

- The major types of molecules that make up living organisms and how these molecules enable life functions.
- The structures found in cells and the functions of those sub-cellular structures.
- The processes by which cells replicate to produce genetically identical, or genetically variable, daughter cells.
- The roles carbohydrates play in biological systems
- The structure and function of proteins
- Nucleic acids and the role they play in DNA and RNA
- Thermodynamics as applied to biological systems
- Identification and classification of microorganisms.

Text Books:

- N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, ―Biology: A global approach‖, Pearson Education Ltd, 2014.
- E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, ―Outlines of Biochemistry‖, John Wiley and Sons, 2009.

Reference Books:

- D. L. Nelson and M. M. Cox, ―Principles of Biochemistry‖, W.H. Freeman and Company, 2012.
- G. S. Stent and R. Calendar, ―Molecular Genetics‖, Freeman and company, 1978.
- L. M. Prescott, J. P. Harley and C. A. Klein, ―Microbiology‖, McGraw Hill Higher Education, 2005.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 202 **Course Name:** Human Values
Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Description:

- This course introduces the fundamental of human values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; _Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient _I' and the material _Body'.
2. Understanding the needs of Self (_I') and _Body' - happiness and physical facility.
3. Understanding the Body as an instrument of _I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of _I' and harmony in _I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Unit 3: Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. 4.Holistic perception of harmony at all levels of existence.

Unit 5 : Implications of the above Holistic Understanding of Harmony on Professional Ethics

1.Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

- CLO-1: Develop the basic concept of human values
- CLO-2: To understand the importance of self-exploration process
- CLO-3: To understand harmony at individual levels
- CLO-4: To understand harmony at nature level
- CLO-5: Develop professional ethics

Textbooks:

- Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:

- Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1 - 05%

Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MC-02 **Course Name:** Python
Course Credit Hour: 3hr **Total Contact Hour:** 34hr

Course Objective:

- Master the fundamentals of writing Python programs
- Learn basic Python coding elements such as variables, identifiers and flow control structures.
- Discover how to work with lists and sequence data.
- Write Python functions to facilitate code reuse.
- Work with the Python standard library
- Explore Python's object-oriented features

Course Description:

This is an introductory course designed for any student interested in using computation to enhance their problem solving abilities. No prior experience in programming is necessary. Students will use their problem solving abilities to implement programs in Python. This course will develop a basic understanding the Python programming language

Course Contents:

Unit 1
Introduction to Python: - History of python programming language, thrust areas of python, overview of programming in Python, identifiers, variables, Expressions and statements, Operators and Operands, data types, indentation, comments, reading input.

Unit 2
Control flow Statements:-if statement, if-else statement, if-else-elif control flow statement, nested if statement, the while loops, the for loop, Strings: Creating and storing strings, basic string operations, formatting strings and string operations.

Unit 3
Functions: Built in functions, function definition and calling the function, default parameters, Lists: Creating list, basic list operations, build in functions used in list, list methods, Dictionaries: Creating dictionaries, built on functions used in dictionaries, dictionary methods.

Unit 4
Tuples: Creates tuples, basic tuple operations, tuple methods, Sets: set methods, Basics Object –oriented Programming: classes and objects, creating classes and objects in python, classes with multiple objects, class attributes vs. data attributes .

Course Learning Outcomes (CLOs):

At the end of the course students will demonstrate the ability to

- Understand python identifiers, variables, Expressions, statements, Operators, operand and data types.
- Implement Conditionals and Loops for Python Programs.
- Use functions and represent Compound data using Lists, Tuples, Dictionaries and strings.
- Implement basics object –oriented components.

Text books:

- Bill Lubanovic, Introducing Python- Modern Computing in Simple Packages, O_Reilly Publication.
- Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.

Reference books:

- Guido Van Russom, Fred L. Drake, An Introduction to Python, Network Theory Limited.
- Magnus Lie Hetland, Beginning Python: From Novice To Professional, Pearson Education.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106212/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-05%
Assignment -2	- 05%
Assessment -3(Mid Term-exam)-20%	
Assignment -3	- 05%
Assessment-4/ Quiz	- 05%
Total Internal Assessment	**- 40%**

Analog and Digital Communication Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC08**
Credits:1
List of Experiments:
1. To study the sampling and reconstruction of a given signal.
2. To study amplitude modulation and demodulation.
3. To study frequency modulation and demodulation.
4. To study time division multiplexing.
5. To study pulse amplitude modulation.
8. To study carrier modulation techniques using binary phase shift keying and differential shift keying.
9. To study pulse code modulation & differential pulse code modulation as well as relevant demodulations.
10. To study quadrature phase shift keying & quadrature amplitude modulation.
2. Study of pulse code modulation and demodulation.
3. Study of delta modulation and demodulation and observe effect of slope overload.
4. Study pulse data coding techniques for various formats.
5. Data decoding techniques for various formats.
6. Study of Amplitude shift keying modulator and demodulator.
7. Study of Frequency shift keying modulator and demodulator.
8. Study of Phase shift keying modulator and demodulator.
9. Error Correction and detection using Hamming code.

Analog Electronics Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC10**

Credits:1

1. To find the voltage gain of a CE amplifier and to find its frequency response.
2. Design a single stage RC coupled amplifier(BJT and FET).
3. Design a emitter follower circuit using darlington pair.
4. Design a two stage RC coupled amplifier and plot of frequency v/s gain, estimation of Q factor and bandwidth.
5. To design a Class A and Class B amplifier.
6. Design of inverting, non inverting and differential amplifier.
7. Measurement of common mode gain, Differential mode gain, CMRR, Slew Rate.
8. Application of Op-Amp as summing amplifier, Difference Amplifier, Integrator, Differentiator.
9. Oscillator Sinusoidal oscillator (i) Wein bridge (ii) Phase shift (iii) Colpitt's (iv) Hartley.
10. To design and obtain the frequency response of (i) First order low pass Filter,(ii) First order High Pass Filter , Band Pass Filter.
11. To construct a 3-bit R-2-R ladder type D/A converter using op-amp IC 741.

Microcontroller Lab

Teaching Scheme:- 0L:0T:2P **Paper Code: EC12**
Credits: 1

List of Experiments for microcontroller:

1. Write a program to add starting five natural number, odd number and even number using microcontroller.
2. Write a program to multiply and divide two number using microcontrollers.
3. Write a program to find largest and smallest number using microcontroller.
4. Write a program to interface Stepper motor using 8051 Microcontroller.
5. Write a program to interface a DC Motor using 8051 microcontroller.

List of experiment of 8085/8086 micrporocessor.

1. Using 8085/86 Write two different programs for 16 bit addition, one using instruction DAD and another without using instruction DAD.
2. Using 8085/86 Write assembly language program for 8 bit multiplication and division.
3. Using 8085/86 write an ALP to sum two largest number & smallest number.
4. Using 8085/86 write an ALP to count negative numbers from a given list of 10 numbers.
5. Using 8085/86 write an ALP to add odd & even number & Square of a given no.
6. To obtain interfacing of keyboard controller .
7. To obtain interfacing of DMA controller .
8. To perform microprocessor based traffic light control.

SEMESTER -5

Course Code: EC13 **Course Name:** Electronic Measurement & Instruments
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To understand operation of different instruments.
- To describe different terminology related to measurements.
- To understand the principles of various types of transducers and sensors.

Course Description:

Electronic measuring instruments are widely used for measuring the electrical charge quantity and amount of flow of electricity through different electronic appliances The course deals with topics such as Principle of measurements, Errors, Accuracy, Units of measurements and electrical standards, , introduction to the design of electronic equipment‘s for temperature, pressure, level, flow measurement, speed etc.

Course Contents:

Unit 1

Unit, dimensions and standards: Scientific notations and metric prefixes. SI electrical units, SI temperature scales, other unit systems, dimension and standards. Measurement Errors: Gross error, systematic error, absolute error and relative error, accuracy, precision, resolution and significant figures, Measurement error combination, basics of statistical analysis. PMMC instrument, galvanometer, DC ammeter, DC voltmeter, series ohmmeter.

Unit 2

Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes Digital voltmeter systems, digital multimeters, digital frequency meter system.

Unit 3

Voltmeter and ammeter methods, Wheatstone bridge, low resistance measurements, low resistance measuring instruments AC bridge theory, capacitance bridges, Inductance bridges, Q meter.

Unit 4 CRO: CRT, wave form display, time base, dual trace oscilloscope, measurement of voltage, frequency and phase by CRO, Oscilloscope probes, Oscilloscope specifications and performance. Delay time based Oscilloscopes, Sampling Oscilloscope, DSO, DSO applications.

Unit 5

Instrument calibration: Comparison method, digital multimeters as standard instrument, calibration instrument Recorders: X-Y recorders, plotters.

Course Learning Outcomes (CLOs):

- Employ appropriate instruments to measure given sets of parameters.
- Practice the construction of testing and measuring set up for electronic systems.
- To have a deep understanding about instrumentation concepts this can be applied to Control systems.

Text books:

- David A. Bel, ―Electronic Instrumentation and Measurements‖, 2nd Ed., PHI, New Delhi 2008.
- Oliver and Cage, ―Electronic Measurements and Instrumentation‖, TMH, 2009.

Reference books:

- Alan S. Moris, ―Measurement and Instrumentation Principles‖, Elsevier (Buterworth Heinman), 2008.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105153/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC15
Course Name: Computer Architecture
Course Credit Hour: 3hr
Total Contact Hour: 42hr

Course Objective:

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on microprogramming
- Concepts of advanced pipelining techniques.

Course Description:

- This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems.
- Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors.

Course Contents:

Module 1: Introduction to computer organization (6 hours)
Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

Module 2: Memory organization (6 hours)
System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Module 3: Input – output Organization (8 hours)
Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Module 4: 16 and 32 microprocessors (8 hours)
80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Module 5: Pipelining(8 hours)
Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Module 6: Different Architectures (8 hours)
VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Course learning outcomes:
Understand the concepts of microprocessors, their principles and practices.

- Write efficient programs in assembly language of the 8086 family of microprocessors.

- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor.

Text Books:

- ―Computer Architecture and Organization‖, 3rd Edition by John P. Hayes, WCB/McGraw-Hill

Reference Books:

- ―Computer Organization and Architecture: Designing for Performance‖, 10th Edition by William Stallings, Pearson Education.
- ―Computer System Design and Architecture‖, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Online links for study & reference materials:

NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC16 **Course Name: Probability and Stochastic Processes**
Course Credit Hour: 3hr **Total Contact Hour:** 30hrs

Course Objective:

The main objective of this course is to provide students uunderstand representation of random signals and application in different areas, analysis characteristics of any random processes, make use of theorems related to random signals and understand propagation of random signals in LTI systems.

Course Description:

This course provides an introduction to Probability and Stochastic Processes with applications. Topics include: basic probability, conditional probability, random variables, probability distributions, Markov, Chebyshev and Chernoff bounds , Random sequences and modes of convergence, Transmission of random process.

Course Contents:

Unit-1

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Unit 2

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions.

Unit-3

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

Unit-4

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem. Random process, Stationary processes, Mean and covariance functions. Ergodicity, Transmission of random process through LTI. Power spectral density.

Course Learning Outcomes (CLOs):

- CLO-1: Understand representation of random signals.
- CLO-2: Investigate characteristics of random processes
- CLO-3: Make use of theorems related to random signals
- CLO-4: To understand propagation of random signals in LTI systems.

Text books:

- H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education.
- Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes, McGraw Hill.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,

- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.

Reference books:

- K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
- W. Feller, –An Introduction to Probability Theory and its Applications‖, Wiley.

Online links for study & reference materials:

https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ma19/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: EC17 **Course Name: Digital Signal Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To develop a thorough understanding of the central elements of discrete time signal processing theory and the ability to apply this theory to real-world signal processing applications.
- Use z-transforms and discrete time Fourier transforms to analyze a digital system.
- Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
- Design and understand finite & infinite impulse response filters for various applications.

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.

Course Contents:

Unit 1

Discrete time signals: Sequences; representation of signals on orthogonal basis; Samplingand reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequencyAnalysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit 2

Designof FIR Digital filters: Windowmethod,Park-McClellan's method.Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Lowpass, Bandpass, Bandstop and High pass filters.

Unit 3

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit 4

Introduction to multirate signalprocessing, Application of DSP.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications

Text books:

- S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV**.**

Reference books:

- A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.

- John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
- L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105055/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-1

Course Code : ECEL1 **Course Name: Bio-Medical Electronics**
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective :

To study the working of different medical equipments

Course Description :

Bio medical electronics (**BME**) is the application of engineering principles and design concepts to medicine and biology for healthcare purposes (e.g. diagnostic or therapeutic). This field seeks to close the gap between engineering and medicine, combining the design and problem solving skills of engineering with medical and biological sciences to advance health care treatment, including diagnosis, monitoring, and therapy.

Course Contents :

Unit 1

Introduction to the physiology of cardiac, nervous & muscular and respiratory systems. Transducers and Electrodes: Different types of transducers & their selection for biomedical applications. Electrode theory, selection criteria of electrodes & different types of electrodes such as, Ag – Ag Cl, pH, etc.

Unit 2

Cardiovascular measurement: The heart & the other cardiovascular systems. Measurement of Blood pressure-direct and indirect method, Cardiac output and cardiac rate. Electrocardiography-waveform-standard lead systems typical ECG amplifier, phonocardiography, Ballisto cardiography, Cardiac pacemaker –defibrillator –different types and its selection.

Unit 3

EEG Instrumentation requirements –EEG electrode –frequency bands – recording systems EMG basic principle-block diagram of a recorder –pre amplifier. Bed side monitor –block diagram- measuring parameters-cardiac tachometer-Alarms-Lead fault indicator-central monitoring. Telemetry – modulation systems – choice of carrier frequency – single channel telemetry systems.

Unit 4

Instrumentation for clinical laboratory: Bio electric amplifiers-instrumentation amplifiers isolation amplifiers-chopper stabilized amplifiers –input guarding – Measurement of pH value of Blood-blood cell counting, blood flow, Respiratory transducers and instruments.

Mode of Evaluation: The theory and lab performance of students are evaluated separately.

Course Learning Outcomes (CLOs) :

On completion of this course, the students will be able to

- Introduce the student to the electronic devices and theory of operation in the medical area.
- Data Interpretation: Learn to design, test, and analyze electronic circuits using oscilloscopes and other electronic test equipment. Apply knowledge of engineering and science to interpret data. Develop an understanding of and develop the skills necessary to communicate findings and interpretations in an effective laboratory report.

- Electronic circuits for Biomedical Applications: Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits. Understand how to apply, measure circuit performance, and solve problems in the areas of biomedical signals.
- Work in Multi-disciplinary teams: Learn to work and communicate effectively with peers on multi-disciplinary teams to attain a common goal.

Text Books

- J J Carr, ―Introduction to Biomedical Equipment Technology‖ : Pearson Education 4th e/d.

Reference Books

- K S Kandpur, ―Hand book of Biomedical instrumentation‖, Tata McGraw Hill 2nd e/d.
- John G Webster, ―Medical Instrumentation application and design‖, John Wiley 3rd e/d.
- Richard Aston, ―Principle of Biomedical Instrumentation and Measurement

Online links for study & reference materials :

https://www.slideshare.net/CHINTTANPUBLICATIONS/biomedical-electronics-by-j-f-khan-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-1

Course Code: ECEL2 **Course Name: CMOS Design**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

The objectives of the course is to enable students to:

- Impart knowledge of MOS transistor theory and CMOS technologies.
- Impart knowledge on architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology.
- Cultivate the concepts of subsystem design processes.

Course Description :

This is an introductory course which covers basic theories and techniques of digital VLSI design in CMOS technology. In this course, we will study the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes, CMOS design rules, static and dynamic logic structures, interconnect analysis, CMOS chip layout, simulation

Course Contents :

Unit 1
Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

Unit 2
MOS Theory Analysis: Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships,MOS Transistor Threshold Voltage Vth, Gradual channel approximation, MOS Capacitance, Short Channel and Narrow Channel Width Effects, Scaling of CMOS Circuits.

Unit 3
Inverter characteristics:- NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

Unit 4
Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout.

Unit 5
CMOS Circuits and Logic Design Rules:, MOS Layers, Stick Diagrams, Design Rules and Layout, 2µm, 1.2 µm Design Rules, Rules for Vias and Contacts, Stick Diagrams and Simple Symbolic Encodings for NMOS, PMOS, CMOS and BiCMOS Logic Gates.

Unit 6
Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops. Pass Transistor, Transmission Gate

Course Learning Outcomes (CLOs) :

At the end of the course, the students will be able to:

- **CO1 & CO2**: be able to use mathematical methods and circuit analysis models in analysis of CMOS , CMOS fabrication flow and technology scaling.
- **CO3**: Be able to create models of moderately sized CMOS circuits that realize specified digital functions.

- **CO4:** Estimate and optimize combinational circuit delay using RC delay models and logical effort,and optimize interconnect delay and noise
- **CO5:** be able to use the physical design aspects to draw the basic gates using the stick and layout diagrams.
- **CO6**: Be able to design static CMOS combinational and sequential logic at the transistor level, including mask layout.

Text books :

- Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.
- Neil H.E.Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 1998.
- J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.

Reference books :

- C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.
- L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.
- K. Martin, Digital Integrated circuit design, Oxford University press, 2001.
- A.Mukherji, Introduction to nMOS and CMOS VLSI system design, Prentice Hall Inc., 1986.
- C.Mead and L.Conway, Introduction to VLSI systems, Addison Wesley, 1986.

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-1

Course Code: ECEL3 **Course Name: Information Theory and Coding**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the basics of information theory and coding theories.
- Introduce the concept of amount of information, entropy, channel capacity, errordetection and error-correction codes, block coding, convolution coding, and Viterbi decoding algorithm.
- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.

Course Description:

This course comprises of the concepts of entropy, mutual information, the Asymptotic Equipartition property, applications to source coding (data compression), applications to channel capacity (channel coding), differential entropy and its application to waveform channel capacities, and a subset of advanced topics such as Kolmogorov complexity, timing (covert) communications, or rate-distortion theory, as time permits. The second half of the course comprises Hamming codes, cyclic codes (CRC and BCH codes), a brief introduction to Reed-Solomon codes, and perhaps universal codes (Lempel-Ziv coding). Students will be encouraged to choose non-traditional applications of information theory or coding for the course research project.

Course Contents:

Unit 1

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless codingtheorem; Encoding of discrete sources.Different types of optical fibers, Modal analysis of a step index fiber.

Unit 2

Markov sources; Shannon's noisy coding theorem and converse for discrete channels;Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Unit 3

Techniques of coding and decoding; Huffman codes and uniquely detectable codes

Unit 4

Cyclic codes, convolutional arithmetic codes.

Course Learning Outcomes(CLOs) :

- Understand the concept of information and entropy
- Understand Shannon‘s theorem for coding
- Calculation of channel capacity
- Apply coding techniques

Text books:

- N. Abramson, Information and Coding, McGraw Hill, 1963.
- M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Reference books:

- R.B. Ash, Information Theory, Prentice Hall, 1970.
- Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102117/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 501 **Course Name:** Organization Behavior

Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- The student will acquire knowledge of organizational behavior including workplace environment, leadership skills, and organization management.
- To enhance the understanding of the dynamics of interactions between individuals and the organization. To facilitate a clear perspective to diagnose and effectively handle human behavior issues in Organization and to develop greater insight into their behavior in interpersonal and groups and team.

Course Description:

- This course introduces the fundamental of organizational behavior includes important insights about motivation, leadership, perception, and learning theories.

Course Contents:

Unit 1: Introduction of OB: (6 lectures)

The concept and nature of OB, need to understand human behavior, Its significance, and impact, Challenges, and opportunities.

Unit 2: Individual dimensions of behavior:(8 lectures)

Individual characteristics, Ability, Values, Attitudes, Formation, Organization related attitude, Relationship between attitude and behavior, Personality, Types, Determinants and traits, learning and Learning theories, Motivation and Motivation theories.

Unit 3: Group behavior and team development: (8 lectures)

Concept of groups and group dynamics, Types of groups, Formal and Informal group, Stages of group development, Group cohesiveness, Group decision making, Concept of team vs group, Types of teams, Managing teams.

Unit 4: Organizational culture and conflict management: (8 lectures)

Organizational culture, Leadership: What is leadership, types of leaders and leadership styles, traits and qualities of an effective leader, managing conflicts, resolution of conflicts, Change management.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of organization and types.

CLO-2: Inculcate skills and understand behavior.

CLO-3: To understand group behavior and emotional development.
CLO-4: To understand organization culture and management.

Textbooks:

(i) Fred Luthans, ―Organizational Behavior‖, 12th Edition, McGraw Hill International Edition
(ii) Stephen P. Robbins, ―Organizational Behavior‖, 12th Edition, Prentice Hall
(iii) Aswathappa K, ―Organizational Behavior (Text, Cases, and Games)‖, Himalaya Publication

Reference books:
Udai Pareek, ―Organizational Behavior‖, Oxford University Press

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

EC18: Digital Signal Processing Laboratory [0L:0T:2P 1 credit]

Hands-on experiments related to the course contents EC17

EC14: EMI Laboratory [0L:0T:2P 1 credit]
Hands-on experiments related to the course contents EC13

SEMESTER -6

Course Code: EC19

Course Name: Control Systems

Course Credit: 3

Total Contact Hour: 40hr

Course Objective :

- To understand fundamental concepts of Control systems and mathematical modelling of the system.
- To understand concept of time response and frequency response of the system.
- To understand basics of stability analysis of the system.

Course Description:

This course provides an introduction to linear systems, transfer functions, and Laplace transforms. It covers stability and feedback, and provides basic design tools for specifications of transient response. It also briefly covers frequency-domain techniques.

Course Contents:

Unit 1

Introduction to control problem- Industrial Control examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2

Feedback control systems- Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems.

Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

Unit 4

Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution

Unit 5

State variable Analysis- Concepts of state, state variable, state model, state modelsfor linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

Introduction to Optimal control & Nonlinear control, Optimal Control problem,Regulator problem, Output regulator, treking problem. Nonlinear system – Basic concept & analysis.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Characterize a system and find its study state behavior
- Investigate stability of a system using different tests
- Design various controllers

- Solve liner, non-liner and optimal control problems

Text books:

- Gopal. M., ‒Control Systems: Principles and Design‖, Tata McGraw-Hill, 1997.
- Kuo, B.C., ―Automatic Control System‖, Prentice Hall, sixth edition, 1993.

Reference books:

- Ogata, K., ―Modern Control Engineering‖, Prentice Hall, second edition, 1991.
- Nagrath & Gopal, ‒Modern Control Engineering‖, New Age International, New Delhi

Online links for study & reference materials:

https://nptel.ac.in/courses/107/106/107106081/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EC20

Course Name: Computer Networks

Course Credit Hour: 3hr

Total Contact Hour: 35hr

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Description:

The course covers the basic and advanced concepts and techniques of Computer Networks from both theoretical and practical perspective. The material includes Data communication Components, Data Link Layer and Medium Access Sub Layer, Network Layer, Transport Layer and Application Layer. The students will be able to understand almost all algorithms required to understand real world network issues.

Course Contents:

Unit-1

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit-2

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA.

Unit-3

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routingprotocols.

Unit-4

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-5:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Course Learning Outcomes (CLOs):

- **CLO-1**: Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- **CLO-2:** For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
- **CLO-3**: For a given problem related TCP/IP protocol developed the network

programming.

- **CLO-4**: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text books:

- BehrouzA. Frozen, Data Communication and Networking, 4th Edition, McGraw- Hill.
- William Stallings, Data and Computer Communication, 8th Edition, , Pearson Prentice Hall India.

Reference books:

- Andrew S. Tanenbaum , Computer Networks, 8th Edition, , Pearson New International Edition.
- Douglas Comer , Internetworking with TCP/IP, Volume 1, 6th Edition , Prentice Hall of India.
- Richard Stevens , TCP/IP Illustrated, Addison-Wesley, United States o f America.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105183/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-2

Course Code : ECEL04 **Course Name : Introduction to MEMS**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective : The goal of this course is to introduce students to MEMS devices, microsystems and their applications as follows

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Description : Micro-electro-mechanical is one of the emerging fields.. The course will start with an introduction on the mechanical and electrical properties of materials commonly used in MEMS. The micro-fabrication processes, including bulk and surface micromachining processes for realization of these micro/nano transducers will be discussed, along with integration of MEMS with CMOS electronics. Some representative sensors and actuators, including capacitive & piezoelectric pressure sensors, mechanical resonators and filters, minimally invasive implantable medical devices, and biomedical lab-on-a-chip will be used to illustrate the capabilities & advantages of these miniaturized devices. This course designs for the give the knowledge of the fabrication of different micro electronics system. It covers the different topic related with the micro system, fabrication technology at micro level.

Course Contents :

Unit1

INTRODUCTION Intrinsic Characteristics of MEMS – Energy Domains and Transducers-Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

Unit2

SENSORS AND ACTUATORS-I Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

Unit3

SENSORS AND ACTUATORS-II Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

Uint4

MICROMACHINING Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies –Basic surface micro machining processes –

Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.
Unit 5
POLYMER AND OPTICAL MEMS Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Text Books:

- Chang Liu, ‗Foundations of MEMS', Pearson Education Inc., 2012.
- Stephen D Senturia, ‗Microsystem Design', Springer Publication, 2000.
- Tai Ran Hsu, ―MEMS & Micro systems Design and Manufacture‖ Tata McGraw Hill, New Delhi, 2002.

References Books:

- Nadim Maluf,― An Introduction to Micro Electro Mechanical System Design‖, Artech House, 2000.
- Mohamed Gad-el-Hak, editor, ― The MEMS Handbook‖, CRC press Baco Raton, 2001.
- Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
- James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
- Thomas M.Adams and Richard A.Layton, ―Introduction MEMS, Fabrication and Application,‖ Springer, 2010.

Course Learning Outcomes(CLOs) :

- **CLO1** : Ability to understand the operation of micro devices, micro systems and their applications.
- **CLO2 &CLO3** : able to understand the concept of sensors and actuators, their uses& application
- **CLO4** : Ability to design the micro devices, micro systems using the MEMS fabrication process
- **CO5:-Able to understand about the** polymer and optical mems

Online links for study & reference materials :

https://nptel.ac.in/courses/117/105/117105082/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-2

Course Code: ECEL5 **Course Name:** Electromagnetic Waves

Course Credit:3 **Total Contact Hour:** 40hr

Course Objective:

- To introduce students with different coordinate systems.
- To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.
- To expose the students to the ideas of electromagnetic waves and structure of transmission line.

Course Description:

This course includes the knowledge of Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields. It distinguishes between the static and time-varying fields establish the corresponding sets of Maxwell's Equations and Boundary Conditions. It analyzes the Wave Equations for good conductors, good dielectrics and evaluate the UPW Characteristics for several practical media of interest.

Course Contents:

Unit 1

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmitssion line sections as circuit elements.

Unit 2

Maxwell's Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Unit 3

Uniform Plane Wave- Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor.

Unit 4

Plane Waves at a Media Interface- Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Unit 5

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Unit 6

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna.

Course Learning Outcomes (CLOs):

- Understand characteristics and wave propagation on high frequency transmission lines.
- Use sections of transmission line sections for realizing circuit elements.
- Characterize uniform plane wave.

- Calculate reflection and transmission of waves at media interface
- Understand principle of radiation and radiation characteristics of an antenna

Text books:

- E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
- Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.

Reference books:

- R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101056/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-2

Course Code: ECEL06 | **Course Name: Speech and Audio Processing**
Course Credit: 3 | **Total Contact Hour:** 40hr

Course Objective:

- To introduce the models of speech and audio production and acoustic phonetics
- To teach time and frequency domain techniques for estimating speech parameters
- To teach predictive techniques for speech coding
- To introduce speech recognition and speech synthesis applications

Course Description:

This course covers the basic principles of digital speech processing, fundamentals of speech production and perception with basic techniques for digital speech processing: like short – time energy, magnitude, autocorrelation ,short – time Fourier analysis ,homomorphic (convolutional) methods, linear predictive methods – Speech estimation methods ,speech/non-speech detection , voiced/unvoiced/non-speech segmentation/classification , Applications of speech signal processing , Speech coding , Speech synthesis, Speech recognition/natural language processing

Course Contents:

Unit 1

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit 2

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Unit 3

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Unit 4

Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero- state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Unit 5

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically model the speech signal
- Analyze the quality and properties of speech signal.
- Modify and enhance the speech and audio signals.

Text books:

- ―Digital Speech‖ by A.M.Kondoz, Second Edition (Wiley Students‟ Edition), 2004.

Reference books:

- ―Speech Coding Algorithms: Foundation and Evolution of Standardized Coders‖, W.C. Chu, WileyInter science, 2003.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105145/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-3

Course Code: ECEL07 | **Course Name:** Power Electronics

Course Credit: 3 | **Total Contact Hour:** 40hr

Course Objective:

- To understand and acquire knowledge about various power semiconductor devices.
- To prepare the students to analyze and design different power converter circuits.

Course Description:

The course focuses on presenting concepts for conversion, control and monitoring of electric energy using power semiconductor devices.Methods for analyzing power electronic converters suitable for AC/DC, DC/DC and DC/AC electrical energy conversions including resonance converters are presented. Additionally, principles for designing power electronic converters, including their power semiconductors and passive elements are established. Computer-aided analysis and simulations of the electrical and thermal performance of power electronic converters is also among the course objectives.

Course Contents:

Unit 1

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT-Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit 2

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit 3

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Unit 4

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Unit 5

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters-need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Build and test circuits using power devices such as SCR
- Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
- Learn how to analyze these inverters and some basic applications.

Text books:

- Muhammad H. Rashid, ―Power electronics‖ Prentice Hall of India.
- Ned Mohan, Robbins, ―Power electronics‖, edition III, John Wiley and sons.

Reference books:

- P.C. Sen., ‒Modern Power Electronics‖, edition II, Chand& Co.
- V.R.Moorthi, ―Power Electronics‖, Oxford University Press.
- Cyril W., Lander,‖ Power Electronics‖, edition III, McGraw Hill.
- G K Dubey S R Doradla,: Thyristorised Power Controllers‖, New Age International Publishers. SCR manual from GE, USA.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/102/108102145/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-3

Course Code : ECEL8 **Course Name :** Nano electronics

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

Students undergoing this course are exposed to:

- Know the types of nanotechnology, atomic structure, molecular technology and preparation of nano materials.
- Understand the fundamentals of nano electronics and its properties.
- Know the Silicon MOSFET‘s, QTD and carbon nano tubes.
- Understand the fundamentals of molecular electronics.

Course Description :

The major goals and objectives are to provide graduate students with knowledge and understanding of physical background and applications of nanoelectronics. The course will cover electrical and optical properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices, as well as applications of nanotechnologies in molecular biology and medicine.

Course Contents :

Unit 1

Introduction To Nanotechnology:- Introduction: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics From microelectronics towards biomolecule electronics Background to nanotechnology: Types of nanotechnology and nanomachines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space – top down and bottom up. Molecular Nanotechnology: Electron Microscope – Scanning Electron Microscope – Atomic Force Microscope –Scanning Tunneling Microscope. Nanomaterials: Preparation –Plasma Arcing – Chemical Vapor Deposition – Sol-Gels – Electrode Position – Ball Milling –Applications Of Nanomaterials.

Unit 2

Fundamentals Of Nanoelectronics:-Fundamentals of logic devices:- Requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation:- power dissipation limit – dissipation in reversible computation – the ultimate computer.

Unit 3

Silicon MOSFET & Quantum Transport Devices:-Silicon MOSFETS - Novel materials and alternate concepts:- fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applicationssingle electron devices – applications of single electron devices to logic circuits.

Unit 4

Carbon Nanotubes:-Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube fets – Nanotube for memory applications – prospects of all carbon nanotube nanoelectronics.

Unit 5

Molecular Electronics:-Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices

Course Learning Outcomes(CLOs) :

Upon the successful completion of the course, students will be able to:

- CLO1: Discuss the types of nanotechnology, molecular technology and the preparation of nano materials.
- CLO2: Explains the fundamental of the devices such as logic devices, field effect devices, and spintronics
- CLO3: Describe the concepts of silicon MOSFET and Quantum Transport Devices.
- CLO4: Summarize the types, synthesis, interconnects and applications of carbon nano tubes.
- CLO 5: Explain the concepts, functions, fabrications and applications of molecular electronics.

Text books :

- Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and Burkhard 2. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
- Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.
- T. Pradeep, NANO: The Essentials – Understanding Nanoscience and Nanotechnology, TMH, 2007.

Reference books :

- M.Ziese and M.J Thornton(Eds.)‖Spin Electronics ―, Springer-verlag 2001.
- M.Dutta and M.A Stroscio Edited by ―Quantum Based Electronic Devices and systems‖, world Scientific, 2000.
- K.E. Drexler, Nanosystems, Wiley, 1992.

- J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
- C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Online links for study & reference materials :

https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

PROGRAM ELECTIVE-3

Course Code: ECEL9 **Course Name:** Scientific Computing

Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To make students familiar with the concepts of programming and the get they accustomed with high-level languages like MATLAB etc.
- To provide an overview of some of the issues and problems that arise in scientific computation, such as (non-)linear systems, numerical and symbolic integration, differential equations and simulation.

Course Description:

After this course the student should be able to understand simple mathematical models and scientific problems (such as finite capacity growth models, plotting a line through data points, etc.) and implement a solution in an adequate scientific programming language (such as MATLAB).

Course Contents:

UNIT-1

Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

UNIT-2

System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

UNIT-3

Eigen-values and singular values: Eigen-values and Eigenvectors, Methods for Computing All Eigen-values, Jacobi Method, Methods for Computing Selected Eigen-values, Singular Values Decomposition, Application of SVD

UNIT-4

Nonlinear equations: Fixed Point Iteration, Newton‘s Method, Inverse Interpolation Method Optimization: One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

UNIT-5

Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences.

Course Learning Outcomes (CLOs):

- Exploring the properties for numerical methods and mathematical models by using the analysis methods covered in the course.

- Understanding the results when running a MATLAB program, and describe a problem with an algorithm or a programming code in MATLAB (which might include self-written MATLAB functions);
- Structure and divide a computational problem into sub-problems, formulate an algorithm and implement the algorithm in MATLAB;

Text books:
- Heath Michael T., ―Scientific Computing: An Introductory Survey‖ , McGraw-Hill, 2nd Ed., 2002
- Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, ―Numerical Recipes: The Art of Scientific Computing‖, Cambridge University Press, 3rd Ed., 2007

Reference books :
- Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, ―Scientific Computing With MATLAB And Octave‖, Springer, 3rd Ed., 2010

Online links for study & reference materials :

https://nptel.ac.in/courses/111/102/111102137/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Constitution of India

EC21: Computer Networks Laboratory [0L:0T:4P 2 credit]

Hands-on experiments related to the course contents EC20

EC22: Control System Laboratory [0L:0T:4P 2 credit]

Hands-on experiments related to the course contents EC19

Course Code : EC23 **Course Name :** Mini Project/Electronic Design Workshop
Course Credit: 2 **Total Contact Hour:** 20hr

Guidelines:

2. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.

3. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

4. Mini Project should cater to a small system required in laboratory or real life.

5. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.

6. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

7. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.

8. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

9. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

10. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

11. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.

- Design, implement and test the prototype/algorithm in order to solve the conceived problem.

- Write comprehensive report on mini project work.

SEMESTER -7

Course Code: ECEL10 **Course Name: Adaptive Signal Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand multirate DSP and design efficient digital filters.
- To construct multi-channel filter banks.
- To select linear filtering techniques to engineering problems.
- To describe the most important adaptive filter generic problems and various adaptive filter algorithms.

Course Description:

This **course** develops the concepts, key issues and motivating examples for adaptive filters; Discrete time linear systems and filters; Random variables and random processes, covariance matrices; Z transforms of stationary random processes. Optimum Linear Systems - Error surfaces and minimum mean square error; Optimum discrete time Wiener filter; Principle of orthogonality and canonical forms; Constrained optimisation; Method of steepest descent - convergence issues; Stochastic gradient descent LMS - convergence in the mean and misadjustment Case study. Least squares and recursive least squares. Linear Prediction - Forward and backward linear prediction; Levinson Durbin; Lattice filters.

Course Contents:

Unit1

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit 2

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 3

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering.

Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank andnullity, innerp roduce space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Unit 4

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 5

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
- Mathematically represent the _adaptability requirement‘.
- Understand the mathematical treatment for the modeling and design of the signal processing systems.

Text books:

- S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

Reference books:

- C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105075/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL11 **Course Name:** Antenna & Propagation
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To introduce the student to antennas, covering their principles of radiation, their basic parameters, (radiation resistance, radiation pattern, polarization, reciprocity, effective radiated power), their general types, and those commonly used in wireless systems.
- Concept of radiation mechanism of various antennas.
- Mechanism and models for radio-wave propagation.

Course Description:

Antenna and Wave Propagation is to introduce to the students the basics of radiating elements and effect of propagation of radio waves in actual environment. This course provides students with comprehensive coverage of a wide variety of antennas and propagation topics related to numerous communication systems with a particular emphasis on military applications.

Course Contents:

UNIT-1

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT-2

Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT-3

Aperture and Reflector Antennas- Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT-4

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

UNIT-5

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Course Learning Outcomes (CLOs):

- Understand the properties and various types of antennas.
- Analyze the properties of different types of antennas and their design.
- Operate antenna design software tools and come up with the design of the antenna of required specifications.

Text books:

- J.D. Kraus, Antennas, McGraw Hill, 1988.
- C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.

Reference books :

- R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.

Online links for study & reference materials :

https://nptel.ac.in/courses/108/101/108101092/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code ECEL12 **Course Name: Digital Image & Video Processing**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the need for image transforms different types of image transforms and their properties.
- To develop any image processing application.
- To understand the rapid advances in Machine vision.
- To learn different techniques employed for the enhancement of images.

Course Description:

This course will cover the fundamentals of image and video processing. We will provide a mathematical framework to describe and analyze images and videos as two- and three-dimensional signals in the spatial, spatio-temporal, and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image/video enhancement, recovery, and compression – but you will also learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools. We will introduce and use a wide variety of such tools – from optimization toolboxes to statistical techniques.

Course Contents:

UNIT 1

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

UNIT 2

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT 3

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

UNIY 4

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

UNIT 5

Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices,

macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.
Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding

Text books:

- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Reference books:

- Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105079/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL13 | **Course Name: Mobile Communication and Networks**
Course Credit: 3 | **Total Contact Hour:** 40hr

Course Objective:

- To study the concept of Mobile radio propagation, cellular system design
- To understand mobile technologies like GSM and CDMA.
- To know the mobile communication evolution of 2G, 3G and 3 GPP in detail.
- To have overview of immerging technologies for 4 G standards.

Course Description:

This Course is to expose the students to the most recent technological developments in Mobile communication systems.. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course.This course deals with various methodologies to improve the received signal quality in mobile communication.The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

Course Contents:

Unit 1

Cellular concepts-Cell structure, frequency reuse, cell splitting, channelassignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Unit 2

Signal propagation-Propagation mechanism- reflection, refraction, diffraction andscattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit 3

Capacity of flat and frequency selective channels. Antennas-Antennas for mobileterminal-monopole antennas, PIFA, base station antennas and arrays.

Unit 4

Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulationschemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKEreceiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Unit 5

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff.Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the working principles of the mobile communication systems.
- Understand the relation between the user features and underlying technology.
- Analyze mobile communication systems for improved performance

Text books:

- WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
- WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

Reference books:

- Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
- AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
- VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Online links for study & reference materials:

http://www.nptelvideos.in/2012/12/wireless-communication.html

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL14 **Course Name:** Mixed Signal Design
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLLs

Course Description:

This course provides the understanding of the practical situations where mixed signal analysis is required and analyze to handle the inter-conversions between signals. It includes the concepts of design systems involving mixed signals.

Course Contents:

UNIT-1

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

UNIT-2

Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

UNIT-3

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT-4

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

UNIT-5

Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

Course Learning Outcomes (CLOs):

- Apply the concepts for mixed signal MOS circuit.
- Analyze the characteristics of IC based CMOS filters.
- Design of various data converter architecture circuits.
- Design of oscillators and phase lock loop circuit.

Text books:

- CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.

Reference books :

- Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Reprint, 2016.

Online links for study & reference materials :

https://nptel.ac.in/content/storage2/courses/117101105/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL15 **Course Name:** Microwave Theory & Techniques
Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- To understand the microwave waveguides, passive & active devices, tubes and network analysis.
- To design microwave matching networks.
- To perform microwave measurements.

Course Description:

Microwaves are everywhere in current technology, especially in the most popular television industries. Microwaves is very much applicable between local and national security channels. For instance, microwaves are used missile guidance infrastructures to control the speed of their missiles as well as parameters.

Course Contents:

UNIT-1

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT-2

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

UNIT-3

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes,

Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

UNIT-4

Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave

Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave

UNIT-5

General measurement setup, Microwave bench, Power measurement – low, Medium & high, Attenuation measurement, Measurement of VSWR, Measurement of dielectric constant, Measurement of Impedance: using Smith Chart, Measurement with spectrum analyzer, Scalar & vector network analyzer operation.

Course Learning Outcomes (CLOs):

- Understand about different modes of wave propagation (TE, TM and TEM) and waveguide structure.
- Knowledge about different microwave components
- Understanding about devices used in microwave generation
- Microwave measurement theory and technology

Text books:

- R.E. Collins, Microwave Circuits, McGraw Hill
- K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

Reference books:

- Liao, S.Y., Microwave Devices & Circuits, Tata McGraw Hill (2006) 2nd edition.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/101/108101112/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Open Elective-3for 7th SEM

Course Code: ECP1 **Course Name:** Project Stage-I
Course Credit: 5

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

SEMESTER -8

Course Code: ECEL16 **Course Name: Fiber Optic Communication**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.

Course Description:

The course is aimed at equipping the undergraduate Engineering and Physics students with the basic understanding of optical fibers and optical fiber communication. The course provides knowledge of optical fiber waveguide at fundamental level, essentials of an optical fiber communication system and understanding of various components of an optical fiber telecommunication system.

Course Contents:

Unit 1
Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.Different types of optical fibers, Modal analysis of a step index fiber.
Unit 2
Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.
Unit 3
Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.
Unit 4
Optical amplifiers - EDFA, Raman amplifier.WDM and DWDM systems. Principles of WDM networks.
Unit 5
Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Course Learning Outcomes(CLOs) :

- Understand the principles fiber-optic communication, the components and the bandwidth advantages.
- Understand the properties of the optical fibers and optical components.
- Understand operation of lasers, LEDs, and detectors
- Analyze system performance of optical communication systems
- Design optical networks and understand non-linear effects in optical fibers

Text books:

- J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).

- T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.

Reference books:

- J. Gowar, Optical communication systems, Prentice Hall India, 1987.
- S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/106/108106167/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL17 **Course Name:** Radar & Satellite Communication

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To become familiar with satellites and satellite services.
- Study of satellite orbits and launching.
- Study of earth segment and space segment components
- Study of satellite access by various users.

Course Description:

The course introduces the students to the basic concept in the field of satellite communication. This will enable the students to know how to place a satellite in an orbit and about the earth & space segment. The satellite services like broadcasting are also studied thoroughly.

Course Contents:

Unit-1

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Unit-2

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit-3

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit-4

Typical Phenomena in Satellite Communication:Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit-5

Satellite link budget, flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes:Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Text books:

- Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002

Reference books:

- Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
- Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105131/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40**

Course Code : ECEL18 **Course Name : High Speed Electronics**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

Aim of this subject is to understand significance and the areas of application of high-speed electronics circuits

Course Description :

Important parameters governing the high speed performance of devices and circuits are described, mainly emphases on transmission line, Noise analysis, RF amplifier design, mixer circuit,oscillators and understanding of PCB Designing is given.

Course Contents :

Unit 1

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses, radiated emissions and minimizing system noise.

Unit 2

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation,Cross-modulation, Dynamic range.

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs highfrequency)

Unit 3

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Unit 4

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Unit 5

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Learning Outcomes(CLOs) :

At the end of the course, students will demonstrate the ability to:

- CLO1 : Understand significance and the areas of application of high-speed electronics circuits.
- CLO2& CLO3: Understand the properties of various components used in high speed electronics
- CLO4 : Design High-speed electronic system using appropriate components.
- CLO5: Understand about CAD tools for PCB Design

Text books :

- Stephen H. Hall, Garrett W. Hall, James A. McCall ‒High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, ‒The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

Reference books :

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, ‒Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, ‒RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Online links for study & reference materials :

https://nptel.ac.in/courses/117/106/117106089/
https://nptel.ac.in/courses/117/104/117104071/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL19 **Course Name:** Wavelets
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To expose to the basics of wavelet theory
- To illustrate the use of wavelet processing for data compression
- To understand denoising and noise suppression.

Course Description:

This course focus on the concepts, methodologies and tools of signal processing using wavelets. We will discuss the basics of wavelets, and aim at the appropriate balance of theory and applications. Topics of interest include multiresolution analysis, wavelet packets, and selected applications to data compression, denoising and signal and image processing.

Course Contents:

Unit 1

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform,

Unit 2

Wigner-Ville transform.;Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis,

Unit 3

Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory,

Unit 4

Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

Course Learning Outcomes(CLOs) :

At the end of the course, students will demonstrate the ability to:

- Understand time-frequency nature of the signals.
- Apply the concept of wavelets to practical problems.
- Mathematically analyze the systems or process the signals using appropriate wavelet functions.

Text books:

- Stephen H. Hall, Garrett W. Hall, James A. McCall –High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices‖, August 2000, Wiley-IEEE Press
- Thomas H. Lee, –The Design of CMOS Radio-Frequency Integrated Circuits‖, CambridgeUniversity Press, 2004, ISBN 0521835399.

Reference books:

- Behzad Razavi, ―RF Microelectronics‖, Prentice-Hall 1998, ISBN 0-13-887571-5.
- Guillermo Gonzalez, –Microwave Transistor Amplifiers‖, 2nd Edition, Prentice Hall.
- Kai Chang, –RF and Microwave Wireless systems‖, Wiley.
- R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Online links for study & reference materials:

https://nptel.ac.in/courses/117/101/117101001/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECEL20

Course Name: Wireless Sensor Network

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

- To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
- Understand the medium access control protocols and address physical layer issues
- Learn key routing protocols for sensor networks and main design issues
- Learn transport layer protocols for sensor networks, and design requirements
- Understand the Sensor management ,sensor network middleware, operating systems.

Course Description:

This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications. Topics will include sensor network architectures, hardware platforms, physical layer techniques, medium access control, routing, topology control, quality of service (QoS) management, localization, time synchronization, security, storage, and other advanced topics. Each student must complete a semester-long course project related to wireless sensor networks.

Course Contents:

Unit 1

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit 2

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit 3

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,

Unit 4

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit 5

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Course Learning Outcomes(CLOs) :

At the end of the course the students will be able to

- Design wireless sensor networks for a given application
- Understand emerging research areas in the field of sensor networks

- Understand MAC protocols used for different communication standards used in WSN
- Explore new protocols for WSN

Text books:

- Waltenegus Dargie , Christian Poellabauer, ―Fundamentals Of Wireless Sensor Networks Theory And Practice‖, By John Wiley & Sons Publications ,2011
- Sabrie Soloman, ―Sensors Handbook" by McGraw Hill publication. 2009

Reference books:

- Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks‖, Elsevier Publications,2004
- Kazem Sohrby, Daniel Minoli, ―Wireless Sensor Networks‖: Technology, Protocols and Applications, Wiley-Inter science
- Philip Levis, And David Gay "TinyOS Programming‖ by Cambridge University Press 2009

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105160/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : ECEL21 **Course Name : Embedded Systems**
Course Credit:3 **Total Contact Hour:** 40hr

Course Objective :

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Description :

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

Course Contents :

Unit 1
Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.
Unit 2
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.
Unit 3
Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.
Unit 4
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.
Unit 5
Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Course Learning Outcomes(CLOs) :

- CLO1 : Expected to understand the selection procedure of Processors in the Embedded domain.
- CLO2: Design Procedure for Embedded Firmware.
- CLO 3: Expected to visualize the role of Real time Operating Systems in Embedded Systems
- CLO 4. Expected to evaluate the Correlation between task synchronization and latency issues

Text books :

- Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference books :

- Embedded Systems - Raj Kamal, TMH.
- Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
- Embedded Systems – Lyla, Pearson, 2013
- An Embedded Software Primer - David E. Simon, Pearson Education.

Online links for study & reference materials :

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/106/105/106105193/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ENTREPRENEURSHIP DEVELOPMENT

Course Code: ECE-802 Credit Units: 04

UNIT -I

Entrepreneurship- definition, growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

UNIT -II

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT -III

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT -IV

Project Planning and control:

The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT -V

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

Course Code: ECP2 **Course Name:** Project Stage -II
Course Credit: 9

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

Information Technology

Course Curriculum

FOR B.TECH-IT COURSE
(Effective from Academic session 2021-2022)

Introduction-B.Tech in Computer Science Engineering, which is commonly known as Computer Science Engineering, is undoubtedly one of the most sought after specialisations of engineering. B.Tech in Computer Science Engineering (CSE) is an academic programme of the duration of four years which integrates the field of Computer Science and Computer Engineering. The programme primarily lays emphasis on the basics of computer programming and networking while also comprising a plethora of topics.

Program Educational Objectives (PEOs)

The Department of Computer Science & Engineering& Information Technology has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of CS/IT Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Programme specific outcome (PSO)

- PSO1: Theoretical Computer Science: Students at the time of graduation will be able to apply fundamental knowledge of theoretical computer science and critically analyze problems to provide computer based solutions for engineering applications.
- PSO2: Hardware and software systems: Students at the time of graduation will be able to design cost effective hardware/software systems and components for engineering/social applications using the knowledge of hardware and/or software architecture, programming and development.
- PSO3: Technology: Students at the time of graduation will be able to apply appropriate technology to find solutions for complex problems.
- PSO4: Research Capability: Students at the time of graduation will be able to apply domain knowledge and expertise for enhancing research capability to transform innovative ideas into reality

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

- **PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B.Tech:

- Every semester shall offer a minimum of **12 credits** and a maximum of 24 **credits**.
- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. tech Degree Course could vary from a **minimum of 158** credits to a **maximum of 178** credits.
- All courses of study put together would engage the students for a **minimum of 26 periods** or hours of study a week and a **maximum of 30 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
    (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to thediscipline or subject of study or which provides an extended scope
    (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain ornurtures the candidate‘s proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	24
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	29
4	Professional core courses	49
5	Professional Elective courses relevant to chosen specialization/branch	18
6	Open subjects – Electives from other technical and /or emerging Subjects	12
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory Courses	0
		*159

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical(Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	15	5.5	20.5
2nd	12	5.5	17.5
3rd	15	8	23
4th	18	6	24
5th	17	7	24
6th	15	7	22
7th	12	3	15
8th	6	6	12
Total	110	48	158

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
PCC : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

Bachelor of Technology-IT

First Semester

S.No	Course Code	Subject	Period			Evaluation Scheme						
						Internal Assessment			External Assessment	Total	Total Credits
			L	T	P	CA	TA	Total			
1	BSC 103	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC102	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC 101	English	2	0	0	20	20	40	60	100	2
4	ESC103	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5	ESC102	Engineering Graphics & Design	1	0	0	20	20	40	60	100	1
		Induction Program	-	-	-	-	-	-	-		0
PRACTICALS											
1	BSC 102P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC103P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	ESC102P	Engineering graphics & Design Lab	0	0	4	-	-	40	60	100	2
4	HSMC101P	English Lab	0	0	2	-	-	40	60	100	1
Total											**20.5**

SECOND SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					
						Internal Assessment			External Assessment	Total	Total Credits
			L	T	P	CA	TA	Total			
1	BSC101	Physics	3	1	0	20	20	40	60	100	4
2	BSC 104	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC104	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	EnvironmentalScience	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC101P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1

THIRD SEMESTER

COURSE		Contact Hours/Week			Credit	Evaluation Scheme				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
BSC301	Discrete Mathematics	3	0	0	2	20	20	40	60	100
ESC302	Digital Electronics	3	0	0	3	20	20	40	60	100
PCC-IT301	Data Structure & Algorithms	3	0	0	3	20	20	40	60	100
PCC-IT302	IT Workshop	1	0	0	1	20	20	40	60	100
PCC-IT303	Unix & Shell Programing	3	0	0	3	20	20	40	60	100
HSMC301	Humanities –I (Human psychology)	3	0	0	3	20	20	40	60	100
PRACTICALS										
ESC302P	Digital Electronics Lab	0	0	4	2	20	20	40	60	100
PCC-IT301P	Data Structure & Algorithms Lab	0	0	4	2	20	20	40	60	100
PCC-IT302P	IT Workshop Lab	0	0	4	2	20	20	40	60	100
PCC-IT303 P	Unix & Shell Programming Lab	0	0	4	2	20	20	40	60	100
Total		**16**	**0**	**16**	**23**					
FOURTH SEMESTER										
PCC-IT401	Computer Based Numerical & Statistical Techniques	3	0	0	3	20	20	40	60	100
PCC-IT402	Computer Organization & Architecture	3	0	0	3	20	20	40	60	100
PCC-IT403	Operating Systems	3	0	0	3	20	20	40	60	100
PCC-IT404	Design &Analysis of Algorithms	3	0	0	3	20	20	40	60	100
HSMC-401	Humanities –II (Human Values)	3	0	0	3	20	20	40	60	100
BSC-401	Biology	2	1	0	3	20	20	40	60	100
PRACTICALS										
PCC-IT402P	Computer Organization & Architecture Lab	0	0	4	2	20	20	40	60	100
PCC-IT403P	Operating Systems Lab	0	0	4	2	20	20	40	60	100
PCC-IT404P	Design &Analysis of Algorithms Lab	0	0	4	2	20	20	40	60	100
Total		**17**	**1**	**12**	**24**					

FIFTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PCC-IT501	Database Management Systems	3	0	0	3	20	20	40	60	100
PCC-IT502	Formal Language & Automata Theory	3	0	0	3	20	20	40	60	100
PCC-IT503	Object Oriented Programming	2	0	0	2	20	20	40	60	100
PCC-IT504	Management Information System	3	0	0	3	20	20	40	60	100
	Elective I	3	0	0	3	20	20	40	60	100
HSMC501	Management I(OB/F&A*)	3	0	0	3	20	20	40	60	100
PRACTICALS										
PCC-IT501P	Database Management Systems Lab	0	0	4	2	20	20	40	60	100
PCC-IT503P	Object Oriented Programming Lab	0	0	4	2	20	20	40	60	100
PROJ-CS50	Industrial Seminar**	0	0	6	3	20	20	40	60	100
Total		**17**	**0**	**14**	**24**					
SIXTH SEMESTER										
PCC-IT601	Web Technology	3	0	0	3	20	20	40	60	100
PCC-IT602	Computer Networks	3	0	0	3	20	20	40	60	100
	Elective II	3	0	0	3	20	20	40	60	100
	Elective III	3	0	0	3	20	20	40	60	100
OEC001	Soft Skills & interpersonal Communication	3	0	0	3	20	20	40	60	100
MC601	Constitution of India	0	0	0	0	20	20	40	60	100
PRACTICALS										
PCC-IT601P	Web Technology Lab	0	0	4	2	20	20	40	60	100
PCC-IT602P	Computer Networks Lab	0	0	4	2	20	20	40	60	100
PROJ-CS60	Project –I**	0	0	6	3	20	20	40	60	100
	Total	**15**	**0**	**14**	**22**					

***OB/F&A- Organizational Behavior/ Finance & Accounting**

****The marks will be awarded on the basis of 06 weeks industrial training conducted after 4th semester**

SEVENTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
	Elective IV	3	0	0	3	20	20	40	60	100
	Elective V	3	0	0	3	20	20	40	60	100
	Elective VI	3	0	0	3	20	20	40	60	100
OEC002	HRD & OB *	3	0	0	3	20	20	40	60	100
PRACTICALS										
PROJ-CS70	Project-II**	0	0	6	3	20	20	40	60	100
Total		**12**	**0**	**6**	**15**					

EIGHTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
OEC003	Cyber Law & Ethics	3	0	0	3	20	20	40	60	100
OEC004	History of science & engineering/ Introduction to philosophical thoughts/ Metro systems and Engineering	3	0	0	3	20	20	40	60	100
PRACTICALS										
PROJ-CS80	Project III**	0	0	12	6	100	100	200	300	500
Total		**6**	**0**	**12**	**12**					

*** HRD & OB- Human Resource Development & Organizational Behavior**

**** Project Synopsis Seminar**

****The marks will be awarded on the basis of Industrial Project Training in 8th semester**

LIST OF ELECTIVES

Thread 1: Theory & Algorithms		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-T 501	Graph Theory
Elective II	PEC-IT-T 601	Advanced Algorithms
Elective III	PEC-IT-T 602	Parallel & Distributed Algorithms
Elective IV	PEC-IT-T 701	Computational Complexity
Elective V	PEC-IT-T 702	Computational Complexity
Elective VI	PEC-IT-T 703	Queuing Theory & Modeling
Additional Subject (can replace with any elective from the same thread): Theory Of Computation		

03

Thread 2: Systems		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-S 501	Advanced Computer Architecture
Elective II	PEC-IT-S 601	Software Engineering
Elective III	PEC-IT-S 602	Distributed Systems
Elective IV	PEC-IT-S 701	Embedded Systems
Elective V	PEC-IT-S 702	Advanced Operating Systems
Elective VI	PEC-IT-S 703	Low Power Circuit & Systems
Additional Subject (can replace with any elective from the same thread): Fault Tolerant Computing		
Thread 3: Data Science & Machine Intelligence		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-D 501	Artificial Intelligence
Elective II	PEC-IT-D 601	Machine Learning
Elective III	PEC-IT-D 602	**Data Mining
Elective IV	PEC-IT-D 701	Soft Computing
Elective V	PEC-IT-D 702	Speech and Natural Language Processing
Elective VI	PEC-IT-D 703	**Data Analytics
Thread 4: Applications		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-A 501	Image Processing
Elective II	PEC-IT-A 601	Digital Signal Processing
Elective III	PEC-IT-A 602	**Cloud Computing
Elective IV	PEC-IT-A 701	Human Computer Interaction
Elective V	PEC-IT-A 702	Electronic Design Automation
Elective VI	PEC-IT-A 703	Computer Graphics

Semester	**Credits**		
	Theory	Practical	Total
1st	15	5.5	20.5
2nd	12	5.5	17.5
3rd	15	8	23
4th	18	6	24
5th	17	7	24
6th	15	7	22
7th	12	3	15
8th	6	6	12
Total	110	48	158

DETAILED 4-YEAR CURRICULUMCONTENTS

Undergraduate Degree in Engineering &Technology

BRANCH/COURSE: INFORMATION TECHNOLOGY

Course Code: BSC101 **Course Name:** Mathematics-I

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems

- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:

https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: BSC102 **Course Name:** Chemistry-I

Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.

  The properties of a compound are not only determined by the functional groups that it contains, but also by the spatial arrangements of the atoms in the molecule. Stereochemistry is the branch of chemistry that is concerned with the three-dimensional structures of molecules.

  After studying this unit I should be able to diastereomer
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, " University chemistry", Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", McGraw- -ill International.
- C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry" (NPTEL).
- K. P. C. Volhardt and N. E. Schore, " Organic Chemistry: Structure and Function" Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam)	-	20%
Assignment-4	-	05%
Assignment-5/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC101 **Course Name:** English

Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication (4 lectures)(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.
- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: ECS101 **Course Name:** Programming for Problem Solving

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays

Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 6: Recursion

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure

Structures, Defining structures and Array of Structures.

Unit 8: Pointers

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

1. Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
2. E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
3. Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving

Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

   R=1 c=1 sum=2
   R=1 c=2 sum=3
   R=2 c=1 sum =3
   R=2 c=2 sum=4
6. Write a program to print the following pattern
7. Write a program to print the square and cube of any given number.
8.

```
*****     *       1
*****     **      12
*****     ***     123
*****     ****    1234
          *****   12345
```

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
    - Find the length of the string.
    - Concatenate two strings
    - Compare two given strings
    - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().

6. Write a program to add two numbers using pointers.
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab

Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr’s Method.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodium hydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

Course Code: BSC102 **Course Name:** Physics

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)

Introduction to Quantum mechanics

Wave nature of particles

Time independent and time dependent Schrodinger equation for wave function

Born interpretation

Probability current

Expectation values

Free particle wavefunction and wave packets

Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)

Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator

Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)

Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)

Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:
https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: BSC103 **Course Name:** Mathematics II

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

Unit 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.

- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.
- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: ESC102 **Course Name:** Workshop/Manufacturing Practices

Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1 Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel. Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual. Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint. **Gas & Spot Welding** To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

Module V Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, “Manufacturing Technology – I” Pearson Education, 2008.
- Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
- Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: ESC104 **Course Name:** Basic Electrical Engineering

Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

Unit 1: DC Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, “ Basic Electrical Engineering”, Tata McGraw Hill.
- D. C. Kulshreshtha, “ Basic Electrical Engineering”, McGraw Hill.

Reference books:

- L. S. Bobrow, “ Fundamentals of Electrical Engineering”, Oxford University Press.
- E. Hughes, “Electrical and Electronics Technology”, Pearson.
- V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: AECCI **Course Name:** Environmental Science

Course Credit Hour: 2hr **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem -Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem

Physical (energy flow), Biological (food chains, food web, ecological succession) and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis

- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity

- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

Unit 5: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

Unit 6: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 200

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):

The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.

- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:

https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Lab Code: BSC101P

Lab Name: Physics Lab

Course Credit Hour: 1.5hr

Total Contact Hour: 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC102P

Lab Name: Workshop/Manufacturing Practice

Course Credit Hour: 2hr

Total Contact Hour: 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: ESC104P **Lab Name:** Electrical Engineering Lab

Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

Course Code: BSC301 **Course Name:** Discrete Mathematics

Course Credit Hour: 2hr **Total Contact Hour:** 40hrs

Course Objective:

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to use mathematically correct terminology and notation, construct correct direct and indirect proofs, use division into cases in a proof, use counter examples and apply logical reasoning to solve a variety of problems.

Course Description:

This course provides wide knowledge ofDiscrete Mathematics. Topics included: Basic of Sets, Relation and function, Principal of mathematical induction, counting technique, propositional logics, algebraic structure and graphs and tree with their applications.

Course Contents:

Unit 1: Sets, Relation and Function (8 hours)

Operations and Laws of Sets, Cartesian Products, BinaryRelation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum andProduct of Functions, Bijective functions, Inverse and Composite Function, Size of a Set,Finite and infinite Sets, Countable anduncountable Sets, Cantor's diagonal argument andThe Power Set theorem, Schroeder-Bernstein theorem.

Unit-2: Principles of Mathematical Induction& Basic Counting Technique (8 hours)

The Well-Ordering Principle, Recursivedefinition, The Division algorithm: Prime Numbers, The Greatest Common Divisor:Euclidean Algorithm, The Fundamental Theorem of Arithmetic.Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination.

Unit 3: Propositional Logic (8 hours)

Syntax, Semantics, Validity and Satisfiability, Basic Connectives andTruth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules ofInference, The use of uantifiers. **Proof Techniques:** Some Terminology, Proof Methodsand Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof ofNecessity and Sufficiency.

Unit 4: Algebraic Structures and Morphism (10 hours)

Algebraic Structures with one Binary Operation,Semi Groups, Monoids, Groups, CongruenceRelation and Quotient Structures,Free and Cyclic Monoids and Groups, Permutation Groups,Substructures, NormalSubgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domainand Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra,Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Unit 5: Graphs and Trees (8 hours)

Graphs and their properties, Degree, Connectivity, Path, Cycle,Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring mapsand Planar Graphs,Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph,definition properties and Example, rooted trees, trees and sorting, weighted trees and prefixcodes, Bi-connected component and Articulation Points, Shortest distances.

Course Learning Outcomes (CLOs):

CLO-1: For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.

CLO-2: For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.

CLO-3: For a given a mathematical problem, classify its algebraic structure.

CLO-4: Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.

CLO-5: Develop the given problem as graph networks and solve with techniques of graph theory.

Text books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill

2. Susanna S. Epp, Discrete Mathematics with Applications,Wadsworth Publishing Co. Inc.

3. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, Tata McGraw – Hill.

Reference books:

1.Discrete Mathematics, Tata McGraw – Hill
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It's Application to Computer Science", TMG Edition, TataMcgraw-Hill.
3. Norman L. Biggs, Discrete Mathematics, Oxford University Press.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: PCCIT-303

Course Name: UNIX and Shell Programming

Course Credit Hour: 3hr

Total Contact Hour: 35hr

Course Objective:

Students undergoing this course are expected to

- State how the shell functions at the user interface and command line interpreter.
- Modify built-in shell variables and create and use user-defined shell variables.
- Create structured shell programming which accept and use positional parameters and exported variables.
- Use shell flow control and conditional branching constructs (while, for, case, if, etc.)
- Use shell debugging mechanisms to improve shell program efficiency and detect.

Course Description:

- The course introduces fundamental concepts in UNIX and Shell Programming including Introduction to Shell Scripts & Awk Programming, General Overview of the System, Functions of UNIX, and Advanced Concepts. Not only do they form basic models of computation, they are also the foundation of many branches of computer science.

Course Contents:

UNIT – 1: Introduction

Introduction to Multi user System- History of UNIX - Features & Benefits - Versions of UNIX, Features of UNIX File System - Commonly Used Commands like who, pwd, cd, mkdir, rm,rmdir, ls, mv, ln, chmod, cp, grep, sed, awk ,tr, yacc etc.

UNIT-2: Introduction to Shell Scripts & Awk Programming

Bourne Shell, C Shell, Shell Variables, Scripts, Meta Characters and Environment, if and case Statements, for, while and until loops. Awk Pattern Scanning and Processing begin and end Patterns, Awk Arithmetic and Variables, built In functions and Operators, Arrays, Strings.

UNIT-3: General Overview of the System

System Structure, User Perspective, Operating System Services Assumption about Hardware, The Kernel and Buffer Cache Architecture of UNIX Operating System, System Concepts, Buffer Headers, Structure of the Buffer Pool, Scenarios for Retrieval of the Buffer, Reading and Writing Disk Blocks, Advantages and Disadvantages of Buffer Cache.

UNIT-4: Functions of UNIX

Unix system, components of Unix, structure of Unix file system, directories, wildcards, finding files, archives, file I/O, backingup, linking, utilities. Unix shell commands, pipes, filters, Login and logout, using korn, bourne and C shells as programming language.

UNIT-5: Advanced Concepts

Limitations of Unix, FTP and Telnet, Regular expression parsing and engines - grep, egrep, sed, awk, vi etc. Process and signals - fork, networking commands, Unix programming in C.

Course Learning Outcomes (CLOs):

Upon the successful completion of the course, students will be able to:

CLO-1: Create structured shell programming

CLO-2: How the shell functions will be used

CLO-3: Filename expansion mechanisms

CLO-4: Create shell programs with process interrupts

Text books:
Harvey M.Deital, Paul Deital, "C - How to Program", Pearson Education Asia Publication

Reference books:
Mullish Cooper, "The spirit of C, Jaico publishing house.
Maurice Bach, "Design of Unix Operating System", PHI.

Online links for study & reference materials:
www.myreaders.info/01_Introduction_to_unix programming.pdf
www.amazon.com/Unix

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

Course Code: ESC 302

Course Name: Digital Electronics

Course Credit: 3

Total Contact Hour: 40hr

Course Objective:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits and to analyze sequential systems.

Course Description:

This course emphasizes on the fundamental of digital electronics. The student is first taught about the number system and logic gates before introducing them to digital IC technology. Then they are exposed to both combinational logic network and combinational MSI logic. In concurrence with this, the fundamental of sequential logic, flip-flop, counter and shift register will be taught. A/D & D/A convertors are summarized. Finally, the memory devices are introduced.

Course Contents:

Module 1:Fundamentals of Digital Systems and logicfamilies (8 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-ORoperations, Boolean algebra, examples ofICgates, number systems-binary, signed binary,octal hexadecimal number, binaryarithmetic,one's and two's complements arithmetic,codes, error detecting and correctingcodes,characteristics of digital lCs, digital logicfamilies, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational DigitalCircuits (8 Hours)

Standard representation for logic functions, K-map representation, simplificationoflogicfunctions using K-map, minimization of logical functions. Don't care conditions,Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry lookahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digitalcomparator,paritychecker/generator, code converters, priority encoders, decoders/driversfor display devices,Q-M method of functionrealization.

Module 3: Sequential circuits and systems (8 Hours)

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T andDtypesflipflops,applicationsofflipflops,shiftregisters,applicationsofshiftregisters,serialtoparallel converter, parallel to serial converter, ring counter, sequencegenerator,ripple(Asynchronous) counters, synchronous counters, counters design using flipflops,specialcounter IC's, asynchronous sequential counters, applications ofcounters.

Module 4: A/D and D/A Converters (8 Hours)

Digital to analog converters: weighted resistor/converter, R-2R LadderD/Aconverter,specifications for D/A converters, examples of D/A converter lCs, sampleand hold circuit,analog to digital converters: quantization and encoding, parallelcomparator A/Dconverter,successive approximation A/D converter, counting A/Dconverter, dual slope A/Dconverter,A/Dconverterusingvoltagetofrequencyandvoltagetotimeconversion,specificationsofA/Dconverters, example ofA/D converterICs

Module 5: Semiconductor memories and Programmable logic devices. (8 Hours)

Memory organization and operation, expanding memory size, classificationandcharacteristicsof memories, sequential memory, read only memory (ROM), read andwrite memory(RAM), content addressable memory (CAM), charge de coupled devicememory (CCD), commonly used memory chips, ROM as a PLD, Programmable logicarray, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Text books:

- Moris Mano, “Digital Logic and Computer Design”, PHI Publications, 2002
- R. P. Jain, “Modern Digital Electronics”, TMH, 3rd Edition, 2003.

Reference books:

- Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
- R.L. Tokheim, “Digital Electronics, Principles and Applications”, Tata McGraw Hill, 1999.
- W. Gothman, “Digital electronics”, PHI.
- S. Salivahanan& S. Arivyhgan. “Digital circuits and design”, Vikas Publication, 2001
- Malvino Leach, "Digital Principles and Application", TMH, 1999.
- V. Rajaraman : Computer Fundamentals (PHI)

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-IT301 **Course Name:** Data Structure & Algorithms

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data structures.

Course Description:

- Study of advanced programming topics focused on logical structures of data as well as the design, implementation and analysis of algorithms operating on these structures.
- Topics include linked lists, stacks, trees, queues, graphs and analysis of efficiency. Also covers searching, sorting and hashing techniques.

Course Contents:

Module 1: Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module 2: Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3: Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Module 4: Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Course learning outcomes:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Suggested books:

1. “Fundamentals of Data Structures”, Illustrated Edition by Ellis Horowitz, SartajSahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition byMarkAllen Weiss, Addison-Wesley Publishing Company
2. “How to Solve it by Computer” , 2nd Impression by R. G. Dromey, Pearson Education.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-IT302

Course Name: IT Workshop (MATLAB)

Course Credit Hour: 1hr

Total Contact Hour: 15hr

Course Objective

- To Impart the Knowledge to the students with MATLAB software.
- To provide a working introduction to the MATLAB technical computing environment.
- To introduce students the use of a high-level programming language using MATLAB.

Course Description:

- The course covers the basic concepts and techniques of MATLAB computing environment from both theoretical and practical perspective. The material includes Introduction to Matlab, Historical Background, Applications and scope of MATLAB, Commands, Data types, Operators, Data and Data Flow, Matlab Advanced Plotting and Mathematical Modeling.

Course Contents:

Unit-1

Introduction to Matlab, Historical Background, Applications, Scope of MATLAB, Importance of MATLAB for Engineers, Features, MATLAB Windows (Editor, Work Space, Command History, Command Window). Operations with Variables, Naming and Checking Existence, Clearing Operations, Commands, Data types, Operators.

Unit-II

Data And Data Flow In Matlab Vectors, Matrix Operations & Operators, Reshaping Matrices, Arrays, Colon Notations, Numbers, Strings, Functions, File Input-Output, Importing and Exporting of data.

Unit-III

Matlab Programming Conditional Statements, Loops, Writing Script Files, Error Correction, Saving Files, Worked out Examples.

Unit-IV

Matlab Advanced Plotting, Graphics, Creating Plot & Editing Plot, GUI (Graphical User Interface). Matlab-Algebra, Calculus, Differential, Integration, Polynomials, solving a system of linear equations.

Unit-V

Simulink Introduction, Importance, Model Based Design, Tools, Mathematical Modeling, Converting Mathematical Model into Simulink Model, Running Simulink Models, Importing Exporting Data, Solver Configuration, Masking Block/Model.

Course Learning Outcomes (CLOs): On completion of the course students will be able to

- **CLO-1**: Understand the introduction of MATLAB environment.
- **CLO-2**: Understand and apply the operation of MATLAB in data flow operations.
- **CLO-3**: Write the various MATLAB programming scripts.
- **CLO-4**: Plot graphs of linear and polynomial equations using various MATLAB functions.
- **CLO-5:** Perform mathematical modeling, importing and exporting of data using Simulink.

Text books:

- Rudra Pratap , Getting Started With Matlab: A Quick Introduction For Scientists And Engineers , OXFORD University Press.
- Y. Kirani Singh, B.B. Chaudhuri , Matlab Programming ,PHI Publication

Reference Books:

- Y. Yang ,Wenwu Cao, Tae-Sang Chung, John Morris ,Applied Numerical Methods Using MATLAB , PHI Publication.

Online links for study & reference materials:

https://nptel.ac.in/courses/103/106/103106118/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 301 **Course Name:** Human Psychology

Course Credit Hour:3Hr **Total Contact Hour:**20hr

Course Objective:

- The student will acquire knowledge of human psychology including workplace environment, Motivation and perception.

Course Description:

- This course introduces the fundamental of human psychology includes important insights about motivation, leadership, perception and work environment.

Course Contents:

Unit 1:Introduction to Psychology(5 lectures)

Definitions & Scope. Types and branches of psychology Major influence on Psychology- Scientific Management and Human relations -Hawthorne Experiments. Taylor Principles, Implications of Psychology on Modern Industries and behavior

Unit 2: Individual at workplace (5lectures)

Attention and Perception, Individual at Workplace-Attitude, Motivation and Job satisfaction. Stress management. Leadership and Group dynamics.

Unit 3:Work Environment & Engineering Psychology-(5 lectures)

Engineering psychology: fatigue, Monotony, Boredom. Accidentsand Safety. Emotional and social development, Cognitive development. Consumer behavior analysis.

Unit 4:Job Analysis (5 lectures)

Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests. Performance Management: Training & Development, Appraisals.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human psychology.

CLO-2: Inculcate leadership and motivational skills.

CLO-3: To understand consumer behavior and emotional development.

CLO-4:To understand about job recruitment process and interviews methods.

Text books:

(i) Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
(ii) Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.

Reference books:

(i) Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.
(ii) Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-IT303P	**Unix & Shell Programming**	**0L:0T: 4P**	**2 credits**

List of Experiments:

1. Execution of various file/directory handling commands.
2. Simple shell script for basic arithmetic and logical calculations.
3. Shell scripts to check various attributes of files and directories
4. Shell scripts to perform various operations on given strings.
5. Shell scripts to explore system variables such as PATH, HOME etc.
6. Shell scripts to check and list attributes of processes.
7. Execution of various system administrative commands.
8. Write awkscript that uses all of its features.
9. Use sedinstruction to process /etc/password file.
10. Write a shell script to display list of users currently logged in.

ESC302P	**Digital Electronics Lab**	**0L:0T:4P**	**2 credits**

LIST OF EXPERIMENTS

1. Verification of NAND, NOR, Ex-OR,AND& OR Gates.
2. Implementation of half Adder & Full Adder
3. Implementation of half Subtractor & Full Subtractor.
4. Implementation of Demultiplexer / Decoder operation using IC-74138.
5. Implementation of Seven segment display.
6. Implementation of Binary to gray converter.
7. Implementation of Arithmetic algorithms.
8. Implementation of various flip-flops.
9. Implementation of Counters.
10. Implementation of shift register.
11. Verification of Transfer characteristics of TTL inverters & TTL Schmitt Trigger inverter.

PCC-IT301P	**Data Structure & Algorithms**	**0L:0T: 4P**	**2 credits**

LIST OF EXPERIMENTS

Write programs in C for following:

1. Write a program to demonstrating Linear Search
2. Write a program to demonstrating Binary Search
3. Write a program to demonstrating Bubble Sort
4. Write a program to demonstrating Selection Sort
5. Write a program to demonstrating Insertion Sort
6. Write a program to demonstrating Merge Sort
7. Write a program to demonstrating Quick Sort
8. Write a program to demonstrating all operations on String without using standard library file
9. Write a program to demonstrating Single Linked List
10. Write a program to demonstrating Stack operations using array/Linked List
11. Write a program to demonstrating Queue operations using Linked list/Array
12. Program for demonstrating Binary Search Tree Using Linked List/Array

PCC-IT302P	IT Workshop Lab	0L:0T: 4P	2 credit

LIST OF EXPERIMENTS

1. Write a Program in M File to find the roots of a Quadratic Equation.
2. Consider the Matrix A=

[1 2 3 5 4 4 5 6 1 3 7 8 9 2 2]

Write a MATLAB Code to obtain the following matrix

[7 8 2 2 4 5 1 3 1 2 5 4]

3. W.A.P in MATLAB to solve the following linear equation:

$$3x^4 + x^3 + 6x^2 + x + 4 = 0$$

$$x^4 + 3x^3 + 2x^2 + 41 = 0$$

4. W.A.P to plot the following two functions for 30 Data Points from 0 to 2π by using Plot Command.
5. W.A.P to display the AND,OR & NOT Program
6. W.A.P. in MATLAB to convert Centigrade values to Fahrenheit values. The Values of the the temp in Centigrade will be taken as input from the user.
7. W.A.P to create a recursive function to find the factorial of a number.
8. W.A.P in MATLAB to show the use of the following operators
   (i) All operator (ii) any operator
9. Create a MATLAB Code to create the chessboard on a white background.
10. W.A.P in MATLAB to make a ribbon plot of the following function
    Z = 20 + Cos (0.5 * x) + 20 * Sin(0.5 * y)

Course Code: PCC-IT401 **Course Name:** Computer Based Numerical & Statistical Techniques

Course Credit Hour: 3hr **Total Contact Hour:**40hrs

Course Objective:

A good Engineer has to have an excellent background of Mathematics. Numerical and statistical techniques are one of the essential tools for learning Technology. This course is tofamiliarisethe students with statistical and numerical techniques needed in problem-solving and industrial applications.

Course Description:

This course provides an introduction to numbers and accuracy and wide knowledge of methods for solving transcendental equation, Interpolation, numerical integration and differentiation, solution of differential equation and statistical technique with their applications.

Course Contents:

Unit 1: (8 hours)

Introduction: Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphsonmethod, Methods of finding complex roots, Muller‟s method, Rate of convergence ofIterative methods, Polynomial Equations.

Unit 2: (10 hours)

Interpolation: Finite Differences , Difference tables Polynomial Interpolation:Newton's forward and backward formula Central Difference Formulae: Gauss forwardand backward formula, Stirling‟s, Bessel‟s, Everett‟s formula.Interpolation with unequal intervals: Langrange‟s Interpolation, Newton Divideddifference formula, Hermite‟s Interpolation

Unit 3: (12 hours)

Numerical Integration and Differentiation: Introduction, Numerical differentiationNumerical Integration: Trapezoidal rule, Simpson‟s 1/3 and 3/8 rule, Boole‟s rule,Waddle‟s rule.

Solution of differential Equations: Picard‟s Method, Euler‟s Method, Taylor‟sMethod, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoringand Stability of solution.

Unit 4: (10 hours)

Statistical Computation: Frequency chart, Curve fitting by method of least squares,fitting of straight lines, polynomials, exponential curves etc, Data fitting with Cubicsplines, Regression Analysis, Linear and Non-linear Regression, Multiple regression,Statistical Quality Control methods.

Course Learning Outcomes (CLOs):

CLO-1: Recognize the error in the number generated by the solution.

CO2. Compute solution of algebraic and transcendental equation by numerical methods.

CLO-3: Apply method of interpolation and extrapolation for prediction.

CLO-4:Evaluation of numerical differentiation and integration.

CLO-5: To find solution of differential equation.

CLO-6: Computation of statistical technique.

Text books:

1. Grewal B S, "Numerical methods in Engineering and Science", Khanna Publishers, Delhi.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

Reference books:

(i) Numerical Method Principles, analysis and algorithms ,Srimamta Pal (Oxford Higher ed).
(ii) Rajaraman V, "Computer Oriented Numerical Methods", PHI, 3rd edition.

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106033/

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	04%
Assignment -2	-	04%
Assessment-3(Mid-Exam)	-	20%
Assignment-3	-	04%
Assignment-4	-	04%
Assignment-5	-	04%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-IT402 **Course Name:** Computer Organization & Architecture

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- How Computer Systems work & the basic principles
- Instruction Level Architecture and Instruction Execution
- The current state of art in memory system design
- How I/O devices are accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism
- To impart the knowledge on microprogramming
- Concepts of advanced pipelining techniques.

Course Description:

- This course provides students with a solid understanding of fundamental architectural techniques used to build today's high-performance processors and systems.
- Course topics include pipelining, superscalar, out of order execution, multithreading, caches, virtual memory, and multiprocessors.

Course Contents:

Module 1:Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTLinterpretation ofinstructions, addressing modes, instruction set. Case study – instruction sets of some commonCPUs.
Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-andadd, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating pointarithmetic.

Module 2:Introduction to x86 architecture.CPU control unit design: hardwired and microprogrammed design approaches, Case study – design of a simple hypotheticalCPU.Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics:Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process statetransitions, I/O device interfaces – SCII, USB

Module 3: Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.Parallel Processors:Introduction to parallel processors, Concurrent access to memory and cachecoherency.

Module 4: Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, writepolicies.

Course learning outcomes:

1. "Computer Organization and Design: The Hardware/Software Interface" , 5th Edition by David A. Patterson and John L. Hennessy,Elsevier.
2. "Computer Organization and EmbeddedSystems" , 6th Editionby CarlHamacher, McGraw Hill HigherEducation.

Suggested reference books:

1. “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. “Computer Organization and Architecture: Designing for Performance” , 10th Edition by William Stallings, PearsonEducation.
3. “Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and Harry F. Jordan, PearsonEducation.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-IT403 **Course Name:** Operating Systems

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and theircommunication
- To learn the mechanisms involved in memory management in contemporaryOS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

Module 1: Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS OperatingSystem.

Module 2: Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,
Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Module 3: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer/Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4: Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Module 5: Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation–Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Pageallocation– Hardware support for paging, Protection and sharing, Disadvantages ofpaging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

Module 6:I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Course learning outcomes:

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia StudentEdition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC CS404

Course Name : Design & Analysis of Algorithm

Course Credit Hour: 3hr

Total Contact Hour : 42hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description :

Algorithms are the soul of computing. It can be roughly described as creating "recipes" (well defined sequences of computational steps) for getting "things" (computational problems specifying an input-output relation) "successfully" (correctly) "done" (in finite steps and time). This course introduces basic methods for the design and analysis of efficient algorithms emphasizing methods useful in practice. Different algorithms for a given computational task are presented and their relative merits evaluated based on performance measures. The following important computational problems will be discussed: sorting, searching, elements of dynamic programming and greedy algorithms, advanced data structures, graph algorithms (shortest path, spanning trees, tree traversals), string matching, elements of computational geometry, NP completeness.

Course Contents :

Module 1:
Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Module 2:
Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.

Module 3:
Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

Module 4:
Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

Module 5:
Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – PSPAC

Course Learning Outcomes (CLOs):

CLO-1: For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

CLO-2: Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

CLO-3: Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

CLO-4: Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.

CLO-5: Develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

CLO-6: For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

CLO-7: Explain the ways to analyze randomized algorithms (expected running time, probability of error).

CLO-8: Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

Text books :

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 4TH Edition, MITPress/McGraw-Hill, 9780262032933, 0262032937
2. E. Horowitz etal. , Sartaj Sahni, Fundamentals of Algorithms , Computer Science Press 9783540120353, 3540120351

Reference books :

1. Jon Kleinberg and ÉvaTardos, Algorithm Design, 1ST Edition, Pearson, 9788131703106, 813170310X
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 9780471427568, 047142756X

Online links for study & reference materials:

https://lecturenotes.in/subject/12/design-and-analysis-of-algorithm-daa/note

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 401 **Course Name:** Human Values

Course Credit Hour:3Hr **Total Contact Hour:** 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Description:

- This course introduces the fundamental ofhuman values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.

2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.

2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.

3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

4. Understanding the characteristics and activities of 'I' and harmony in 'I'.

5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

6. Programs to ensure Sanyam and Health.

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature

2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4.Holistic perception of harmony at all levels of existence.

Unit 5 : Implications of the above Holistic Understanding of Harmony on Professional Ethics

1.Natural acceptance of human values

2. Definitiveness of Ethical Human Conduct

3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human values

CLO-2: To understand the importance of self-exploration process

CLO-3: To understand harmony at individual levels

CLO-4: To understand harmony at nature level

CLO-5: Develop professional ethics

Textbooks:

(i) Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
(ii) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:

1.Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: BSC-401 **Course Name:** Biology
Course Credit: 3 **Total Contact Hour:** 33hr

Course Objective:

- ✓ To increase the understanding of living systems.
- ✓ To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
- ✓ To understand the Hierarchy of life forms at phenomenological level.
- ✓ To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”Mendel’s laws, Concept of segregation and independent assortment.
- ✓ To learn the systems in relationship to the self and other organisms in the natural environment.
- ✓ To analyze biological processes at the reductionistic levelProteins- structure and function.
- ✓ To know and learn the fundamental principles of energy transactions.

Course Description:

This course explains the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal and populationlevels of the biological hierarchy.

Course Content:

Module 1. (2 hours)- Introduction
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics andChemistryBring out the fundamental differences between science and engineering by drawing a comparisonbetween eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as anindependent scientific discipline. Why we need to study biology? Discuss how biological observationsof 18th Century that lead to major discoveries. Examples from Brownian motion and the origin ofthermodynamics by referring to the original observation of Robert Brown and Julius Mayor. Theseexamples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification
Purpose: To convey that classification per se is not what biology is all about. The underlyingcriterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchyClassification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b)ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs,heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitataaquaticor terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism cancome under different category based on classification. Model organisms for the study of biologycome from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M.musculus.

Module 3. (4 hours)-Genetics
Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences”Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Genemapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasisto be give not to the mechanics of cell division nor the phases but how genetic material passes fromparent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype togenes. Discuss about the single gene disorders in humans. Discuss the concept of complementationusing human genetics.

Module 4. (4 hours)-Biomolecules
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations areas diverse as one can imagineMolecules of life. In this context discuss monomeric units and polymeric structures. Discuss aboutsugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbonunits and lipids.

Module 5. (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earthEnzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions?Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzymekinetics and kinetic parameters. Why should we know these parameters to understand biology? RNAcatalysis.

Module 6. (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universalMolecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefromsingle stranded to double helix to nucleosomes. Concept of genetic code. Universality anddegeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose: How to analyses biological processes at the reductionistic levelProteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary andquaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biologicalworld.Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonicand exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP asan energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis andKrebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding andenergy consuming reactions. Concept of Energy charge.

Module 9. (3 hours)- Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classificationof microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization andmedia compositions. Growth kinetics.

Course Learning Outcomes(CLOs):

At the end of this course students will learn:

- The major types of molecules that make up living organisms and how these molecules enable life functions.
- The structures found in cells and the functions of those sub-cellular structures.
- The processes by which cells replicate to produce genetically identical, or genetically variable, daughter cells.
- The roles carbohydrates play in biological systems
- The structure and function of proteins
- Nucleic acids and the role they play in DNA and RNA
- Thermodynamics as applied to biological systems
- Identification and classificationof microorganisms.

Text / References:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”,Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley andSons, 2009.
3. D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, “Microbiology”, McGraw Hill Higher Education, 2005.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid-exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-IT402P	Computer Organization &Architecture Lab	0L:0T:4P	2 Credits

List of Experiments

1. To study Half Adder.
2. To study Full Adder (7483).
3. To study ALU (74181).
4. Write a program for hexadecimal addition and multiplication.
5. Write a program for binary multiplication.
6. Write a program for Booth's multiplication.
7. Write programs to simulate memory allocation policies
   a. First-fit algorithm
   b. Best-fit algorithm
8. Write programs to simulate the mapping techniques of Cache memory.
   a. Direct Mapped cache
   b. 2 Associative Mapped cache
   c. Set Associative Mapped cache
9. Write a program to implement stack and branch instructions.
10. Design of 4-bit Universal Shift Registers using D-FF.

PCC-IT403P	**Operating Systems Lab**	**0L:0T:4P**	**2 Credits**

List of Experiments

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Write a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Banker’s algorithm for deadlock avoidance.

PCC-IT404P	**Design and Analysis of Algorithms Lab**	**0L:0T:4P**	**2 Credits**

List of Experiments

1. Write a Program to implement Insertion sort.
2. Write a Program to implement Binary Search using Divide and Conquer.
3. Write a Program to implement Quicksort.
4. Write a Program to implement shortest path algorithm.
5. Write a Program to implement Merge sort using Divide and Conquer.
6. Write a Program to implement Knapsack problem using Greedy method.
7. Write a Program to implement Prim’s algorithm using Greedy method.
8. Write a Program to implement Kruskal’s algorithm using Greedy method.
9. Write a Program to implement Graph Traversal: Breadth First Traversal.
10. Write a Program to implement Graph Traversal: Depth First Traversal.
11. Write a Program to implement 8-Queen’s problem using Backtracking.
12. Write a Program to implement All Pairs Shortest Path Using Dynamic Programming.

Course Code: PCC IT504 **Course Name:** Management Information System

Course Credit Hour: 3 **Total Contact Hour:** 42hr

Course Objective:

Provide students with an understanding at how to use and manage information system in order to revitalize business processes, improve business decision making, and gain competitive advantage.

Course Description:

The use of information and communication technologies (ICT) by individuals and organizations dominates the business world. There is a fundamental change going on in the way that organizations run businesses and interact with each other. New types of infrastructure and applications are developed and utilized such as ERP (enterprise resource planning), IOS (inter-organizational systems), RFID (radio frequency identification), CRM (customer relationship management), to name a few.

Course Contents:

Module I Introduction: Concept of Data and Information, Information Systems, Classification, Operations Support System (OSS), Management Support System(MSS), Transaction Processing System(TPS), Process Control System(PCS), Enterprise Collaboration System(ECS), Management Information System(MIS), Decision Support System(DSS), Expert System(ES), Executive Information System(EIS), Cross Functional Information Systems

Module II Role of MIS: Strategic Advantage with MIS, Competitive Strategy Concept, The Value Chain and Strategic IS, Using IT for Strategic Advantage: Business Process Re-engineering, Creating a Virtual Company, Improving Business Quality: Total Quality Management, Building a Knowledge Creating Company

Module III Developing MIS Systems: System Development Life Cycle. , Investigation Phase, Prototyping, Feasibility Analysis, System Analysis (DFD and ER Diagram), System Design, Implementing Business Systems, Testing, Documenting, Training, Conversion and Maintenance .

Module IV Applications: Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Security and Ethical Challenges Of IT, Ethical Responsibility - Business Ethics, Technology Ethics; Cyber Crime and Privacy Issues.

Course Learning Outcomes (CLOs):

CLO 1: Define the key terms.

CLO 2: Interpret information systems in the enterprise
CLO 3: Explain relationships between concepts of information systems, organization, management and strategy.
CLO 4: Debate infrastructure of information technology
CLO 5: Illustrate redesigning the organization with information systems

Text books :

1. Laudon K C and Laudon J P - Management Information Systems: Managing the Digital Firms (Prentice Hall, 1st Ed.) 9780273779803, 027377980X

2. Robert G. Murdick, Joel E. Ross– Information System For Modern Management (PHI, 3rd Ed.) , 9780876920787, 0876920784

Reference books :

1. Jawedkar W S - Management Information System (Tata Mc Graw Hill, 3rd Ed.) , 9780070445758, 0070445753.
2. Gordon B. Davis, Margrethe H. Olson – Management Information System (TMH, 2nd Ed.) 9780070158306, 0070158304

Online links for study & reference materials:

https://lecturenotes.in/notes/8216-notes-for-management-information-system-mis-by-nihar-ranjan-rout

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC CS 501 **Course Name:** Database Management System

Course Credit Hour: 3 **Total Contact Hour:** 55hr

Course Objective:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data ware housing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Description:

Focuses on concepts and structures necessary to design and implement a database management system. Various modern data models, data security and integrity, and concurrency are discussed. An SQL database system is designed and implemented as a group project.

Course Contents:

Module 1: Database system architecture: DataAbstraction,DataIndependence,DataDefinition Language(DDL), Data Manipulation Language(DML).
Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulationoperations.

Module 2: Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver.

Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Losslessdesign.

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Module 3: Storage strategies: Indices, B-trees, hashing.

Module 4: Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

Module 5: Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

Module 6:
Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

Course Learning Outcomes (CLOs):

CLO1. For a given query write relational algebra expressions for that query and optimize the developed expressions

CLO2. For a given specification of the requirement design the databases using E R method and normalization.

CLO3. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, and DB2.

CLO4. For a given query optimize its execution using Query optimization algorithms

CLO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

CLO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Text books :

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts" , 6th Edition, McGraw-Hill, 9780078022159, 0078022150.

Reference books :

1 J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer SciencePress, 788175155459, 8175155450

2 R. Elmasri and S. Navathe, "Fundamentals of Database Systems" , 5th Edition, PearsonEducation 9788131716250, 8131716252

3 Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley "Foundations of Databases", 9780201537710, 0201537710

Online links for study & reference materials:

https://www.geektonight.com/database-management-systems-notes-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PCC-IT502 **Course Name:** Formal Languages and Automata

Course Credit Hour: 3hr **Total Contact Hour:** 35 hr

Course Objective:

- Develop a formal notation for strings, languages and machines.
- Design finite automata to accept a set of strings of a language.
- Prove that a given language is regular and apply the closure properties of languages.
- Design context free grammars to generate strings from a context free language and convert them into normal forms.
- Prove equivalence of languages accepted by Push down Automata and languages generated by context free grammars
- Identify the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and Undecidability.

Course Description:

- The course introduces fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton, and Turing machine. Not only do they form basic models of computation, they are also the foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems, etc. The properties of these models will be studied and various rigorous techniques for analyzing and comparing them will be discussed, by using both formalism and examples.

Course Contents:

Unit – I Introduction; Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition tabl e, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transi ion, Language of NFA, Equi valence of NFA and DFA, Minimization of Finite Automata, Distinguis hing one string from other, Myhill-Nerode Theorem

Unit – II Regular expression (RE) , Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages . Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.

Unit – III Context free grammar (CFG) and Context Free Languages (CFL): Definition, Examples, Derivation , Derivation trees, Ambiguity in Grammer, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Memership, Pumping lemma for CFLs.

Unit – IV Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA

Unit – V Turing machines (TM): Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computerof Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Write a formal notation for strings, languages and machines.
- **CLO-2**: Design finite automata to accept a set of strings of a language.
- **CLO-3**: Determine whether the given language is regular or not.
- **CLO-4**: Design context free grammars to generate strings of context free language.
- **CLO-5**: Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars.

Text books:

- Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education .
- K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", PHI Learning Private Limited, Delhi India.
- Peter Linz, "An Introduction to Formal Language and Automata", Narosa Publishing house.
- Y.N.Singh "Mathematical Foundation of Computer Science", New Age International.

Reference books:

- K.Krithivasan and R.Rama; Introduction to Formal Languages, Automata Theory and Computation; Pearson Education.
- Harry R. Lewis and Christos H. Papadimitriou, Elements of the theory of Computation, Second Edition, Prentice-Hall of India Pvt. Ltd.
- Micheal Sipser, "Introduction of the Theory and Computation", Thomson Learning.

Online links for study & reference materials:

- https://nptel.ac.in/courses/106/106/106106049/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam	-	20%
Assignment-4	-	05%
Assignment-5/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code : PCC CS 503 **Course Name :** Object Oriented Programming

Course Credit Hour : 2 **Total Contact Hour :** 30

Course Objective: The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, and an appropriate framework for automated unit and integration tests.

Course Description: Object-oriented programming represents the integration of software components into a large-scale software architecture. The course focuses on the understanding and practical mastery of object-oriented concepts such as classes, objects, data abstraction, methods, method overloading, inheritance and polymorphism.

Course Contents:

Module 1: Introduction: The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, importance of modeling, principles of modeling, object oriented modeling, Introduction to UML, conceptual model of the UML, Architecture.

Module II : Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class &Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams, depict a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages.

Basic Behavioural Modeling: Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram.

Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams

Module- III : Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations.

Structured analysis and structured design (SA/SD): Jackson Structured Development (JSD).Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation.

Object oriented programming style: reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation.

Module- IV : Introduction to OOP language: History, Features, Object Oriented concepts, Classes and Objects, Inheritance, Packages, Interface , abstract method and classes, Polymorphism, Inner classes, String Handling, I/O , Networking, Event Handling. Multithreading, Collection, APIs,

Module –V: Swing: Introduction to AWT, AWT v/s Swing, Creating a Swing Applet and Application. Utility of internet programming language, JDBC, The connectivity model, JDBC/ODBC Bridge, Introduction to servlets.

Course Learning Outcomes (CLOs):

CLO1. Specify simple abstract data types and design implementations, using abstraction functions to document them.

CLO2. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.

CLO3. Name and apply some common object-oriented design patterns and give examples of their use.

CLO4. Design applications with an event-driven graphical user interface.

Text books :

1. Liskov, John Guttag, *Program Development in Java*, Addison-Wesley, 2001, 780201657685, 0201657686
2. E Balagurusamy, Programming with Java, McGraw-Hill Education, 9789353162337, 9353162335

Reference books :

1. James Rumbaughet. al, “Object Oriented Modeling and Design”, PHI . 9788131711064, 8131711064
2. Mark Priestley “Practical Object-Oriented Design with UML”, TMH .
3. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language User Guide”, Pearson Education . 9788177583724, 8177583727
4. Naughton, Schildt, “The Complete Reference JAVA2”, TMH .

Online links for study & reference materials:

https://sites.google.com/a/mes.ac.in/oopm/lecture-notes

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Mid exam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: HSMC 501

Course Name: Organization Behavior

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

- The student will acquire knowledge of organizational behavior including workplace environment, leadership skills, and organization management.
- To enhance the understanding of the dynamics of interactions between individuals and the organization. To facilitate a clear perspective to diagnose and effectively handle human behavior issues in Organization and to develop greater insight into their behavior in interpersonal and groups and team.

Course Description:

- This course introduces the fundamental oforganizational behavior includes important insights about motivation, leadership, perception,and learning theories.

Course Contents:

Unit 1:Introduction of OB: (6 lectures)

The concept and nature of OB, need to understand human behavior, Its significance, and impact, Challenges, and opportunities.

Unit 2:Individual dimensions of behavior:(8 lectures)

Individual characteristics, Ability, Values, Attitudes, Formation, Organization related attitude, Relationship between attitude and behavior, Personality, Types, Determinants and traits, learning and Learning theories, Motivation and Motivation theories.

Unit 3:Group behavior and team development: (8 lectures)

Concept of groups and group dynamics, Types of groups, Formal and Informal group, Stages of group development, Group cohesiveness, Group decision making, Concept of team vs group, Types of teams, Managing teams.

Unit 4:Organizational culture and conflict management:(8 lectures)

Organizational culture, Leadership: What is leadership, types of leaders and leadership styles, traits and qualities of an effective leader, managing conflicts, resolution of conflicts, Change management.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of organization and types.

CLO-2: Inculcate skills and understand behavior.

CLO-3: To understand group behavior and emotional development.

CLO-4: To understand organization culture and management.

Textbooks:

(i) Fred Luthans, ―Organizational Behavior‖, 12th Edition, McGraw Hill International Edition
(ii) Stephen P. Robbins, ―Organizational Behavior‖, 12th Edition, Prentice Hall
(iii)Aswathappa K, ―Organizational Behavior (Text, Cases, and Games)‖, Himalaya Publication

Reference books:

1. UdaiPareek, ―Organizational Behavior‖, Oxford University Press

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-IT 501P	**Database Management System Lab**	**0L:0T:4P**	**2 Credits**

LIST OF PROGRAMS

Software Required: Open Source Software - SQL

1. Introduction to MySQL, An exercise on data types in My SQL and DDL commands.
2. Exercise on DML and TCL commands.
3. Exercise on Types of Data Constraints.
4. Exercise on single and multiple table join and using Normalization.
5. Exercise on Order by and Group by Clause and Data arithmetic.
6. Exercise on different functions(Aggregate, math, string)
7. Exercise on Different types of Sub queries.

PCC-IT5033P	**Object Oriented Programming Lab**	**0L:0T:4P**	**2 Credits**

List Of Practical

1. To become familiar with classes that represents entities that can interact with the user.

2. To successfully write simple programs that involve if statements.

3. To gain practice in the use of Boolean operators like && and ||.

4. Write a program to implement 4 types of pyramid.

5. Write a new program called Options that will request that the user enter an integer and then will display the message positive, negative or zero. If the value that was entered was greater than zero, less than zero, or equal to zero, respectively.

6. Write a simple program implement constructor.

7. Write a program to implement inheritance.

8. Write a program to implement function overloading.

Course Code: PCC IT 601 **Course Name:** Web Technology

Course Credit Hour: 3 **Total Contact Hour:** 55hr

Course Objective:

- This course demonstrates an in-depth understanding of the tools and Web technologies necessary for business application design and development. The course covers client side scripting like HTML, JavaScript and server side scripting like servlets, JSPs and also XML and web servers and database interfacing.

Course Description:

- Student will be familiar with client server architecture and able to develop a web application using java technologies. Students will gain the skills and project-based experience needed for entry into web application and development careers.

Course Contents:

Module-I:
HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets; Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script
XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX

Module -II:
Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties, Persistence, Customizes, Java Beans API, Introduction to EJB's

Module -III:
Web Servers and Servlets: Tomcat web server, Introduction to Servelets: Lifecycle of a Servelet, JSDK, The Servelet API, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues,

Module -IV:
Introduction to JSP: The Problem with Servelet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC Setting Up and JSP Environment: Installing the Java Software Development Kit, Tomcat Server & Testing Tomcat

Module -V:
JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations

Module VI:
Database Access: Database Programming using JDBC, Studying Javax.sql.* package,Accessing a Database from a JSP Page, Application – Specific Database Actions,Deploying JAVA Beans in a JSP Page, Introduction to struts framework..

Course Learning Outcomes (CLOs):

CLO 1. Outline the history of the web, and technologies that makes the web pages and publishing them.

CLO2. Make the web pages more dynamic and interactive.

CLO3. Design to create structure of web page, to store the data in web document, and transport information through web.

CLO4. Design to be reusable the software components in a variety of different environments.

CLO5. Install Tomcat Server and execution of programs on server side.

CLO6. Identify the problems in Servlets and overcome those using Java Server Pages also develop JSP applications with Model View Control architecture.

Text books :

1. Chris Bates , Web Programming, building internet applications, 2nd edition,WILEY Dreamtech, 9788126502721, 812650272X
2. Patrick Naughton and Herbert Schildt , The complete Reference Java 2, Fifth Edition ,. TMH 9780070495432, 0070495432
3. Hans Bergsten , Java Server Pages –SPD O'Reilly 9780596528706, 0596528701

Reference books :

1. Sebesta , Programming world wide web-,Pearson 9788131724170, 8131724174
2. Marty Hall and Larry Brown, Core SERVLETS ANDJAVASERVER PAGES , VOLUME 2: CORE TECHNOLOGIES By Pearson 9788131701638, 8131701638
3. Harvey M. Deitel, Paul J. Deitel, Tem R. Nieto,Internet and World Wide Web – How to program, Pearson Education Asia, 9780131218550, 0131218557

Online links for study & reference materials:

https://lecturenotes.in/subject/503

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-IT602 **Course Name:** Computer Networks

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Description:

- The course covers the basic and advanced concepts and techniques of Computer Networks from both theoretical and practical perspective. The material includes Data communication Components, Data Link Layer and Medium Access Sub Layer, Network Layer, Transport Layer and Application Layer. The students will be able to understand almost all algorithms required to understand real world network issues.

Course Contents:

Unit-1

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit-2

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA.

Unit-3

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routingprotocols.

Unit-4

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit-5:

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

Course Learning Outcomes (CLOs):

- **CLO-1**: Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- **CLO-2:** For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.

- **CLO-3**: For a given problem related TCP/IP protocol developed the network programming.
- **CLO-4**: Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text books:

- BehrouzA. Frozen, Data Communication and Networking, 4th Edition, McGraw- Hill.
- William Stallings, Data and Computer Communication, 8th Edition, , Pearson Prentice Hall India.

Reference books:

- Andrew S. Tanenbaum , Computer Networks, 8th Edition, , Pearson New International Edition.
- Douglas Comer , Internetworking with TCP/IP, Volume 1, 6th Edition , Prentice Hall of India.
- Richard Stevens , TCP/IP Illustrated, Addison-Wesley, United States o f America.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105183/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Mid-Term Exam)	-	20%
Assignment-3	-	05%
Assignment-1/Quiz	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: OEC 001 **Course Name:** Soft skills and interpersonal Communication

Course Credit Hour:3Hr **Total Contact Hour:**20hr

Course Objective:

- The student will acquire knowledge of soft skills including motivation, leadership and interview skills.

Course Description:

- This course introduces the fundamental ofsoft skills and hard skills, it includes important insights about motivation, leadership, attitude, stress management and interpersonal communication.

Course Contents:

Unit 1: Soft Skills: An Introduction:

Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. **Self-Discovery:** Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Positivity and Motivation:

UNIT -2: Interpersonal Communication:

Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships7through effective communication; listening skills; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation.**Public Speaking:** Skills, Methods, Strategies and Essential tips for effective public speaking. Group Discussion: Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective.**Non-Verbal Communication:** Importance and Elements; Body Language. **Teamwork and Leadership Skills:** Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills.

UNIT -3: Interview Skills: Interviewer and Interviewee:

Resume writing in-depth perspectives. Before, During and After the Interview. Tips for Success. Presentation Skills: Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness. Etiquette and Manners – Social and Business. Time Management – Concept, Essentials, Tips.

UNIT – 4: Decision-Making and Problem-Solving Skills:

Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict **Management: Conflict -** Definition, Nature, Types and Causes; Methods of Conflict Resolution. **Stress Management: Stress -** Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress**Leadership and Assertiveness Skills:** A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behavior; Assertiveness Skills.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of soft skills

CLO-2: Inculcate leadership and motivational skills.

CLO-3: To understand perception, emotional development and interview skills.

CLO-4:To understand group development and leadership skills

Text books:

(i) Managing Soft Skills for Personality Development –edited by B.N. Ghosh, McGraw Hill India, 2012.
(ii) English and Soft Skills – S.P. Dhanavel, Orient Black swan

Reference books:

(i) Raman, Singh – Business communication – Oxford Press
(ii) Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

PCC-IT601 P	**Web Technology**	**0L:0T: 4P**	**2 credits**

LIST OF EXPERIMENTS

1. Write an HTML code to display your education details in a tabular format.

2. Write an HTML code to display your CV on a web page.

3. Write an HTML code to create a Home page having three links: About Us, Our Services and Contact Us. Create separate web pages for the three links.

4. Write an HTML code to create a login form. On submitting the form, the user should get navigated to a profile page.

5. Write an HTML code to create a Registration Form. On submitting the form, the user should be asked to login with this new credentials.

6. Write an HTML code to create your Institute website, Department Website and Tutorial website for specific subject.

7. Write an HTML code to illustrate the usage of the following: Ordered List, Unordered List, Definition List.

8. Write an HTML code to create a frameset having header, navigation and content sections.

9. Write an HTML code to demonstrate the usage of inline CSS.

10. Write an HTML code to demonstrate the usage of internal CSS.

11. Write an HTML code to demonstrate the usage of external CSS.

12. Write a Java script to prompt for users name and display it on the screen.

13. Design HTML form for keeping student record and validate it using Java script.

14. Write an HTML program to design an entry form of student details and send it to store at database server like SQL, Oracle or MS Access.

15. Write programs using Java script for Web Page to display browsers information.

16. Create an applet which will have a line, an Oval & a Rectangle

17. Writing program in XML and create a style sheet in CSS & display the document in internet explorer.

18. Write an XML program to display products .

19. Write a program using PHP and HTML to create a form and display the details entered by the user.

PCC-IT602 P	**Computer Networks**	**0L:0T: 4P**	**2 credits**

<u>List of Experiments</u>

1. Study of different types of Network cables and practically implements the cross wired cable and straight through cable using clamping tool.

2. To implement & study the peer to peer connection using Cisco packet tracer.

3. To implement & study the bus topology using Cisco packet tracer.

4. To implement & study the star topology using Cisco packet tracer.

5. To implement & study the ring topology using Cisco packet tracer.

6. To implement & study the mesh topology using Cisco packet tracer.

7. To implement and configuration the given network topology having single router through graphical user interface using Cisco Packet Tracer.

8. To implement and configuration the given network topology having single router through command line interface using Cisco Packet Tracer.

9. To implement and configuration the given network topology having multiple routers through graphical user interface using Cisco Packet Tracer.

10. To implement and configuration the given network topology having multiple routers through command line interface using Cisco Packet Tracer.

Course Code: OEC-002 **Course Name:** Human Resource Development

Course Credit Hour:3Hr **Total Contact Hour:**30hr

Course Objective:

- The objective of the course is to make student aware of the concepts, techniques and practices of human resource development. This course is intended to make students capable of applying the principles and techniques as professionals for developing human resources in an organization.

Course Description:

- This course introduces the fundamental of human resource development includes important insights about the human resource process, Organization development, Training methods, and training development.

Course Contents:

Unit 1:HRD-Macro Perspective:(6 lectures)

HRD Concept, Origin, and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate.

Unit 2:HRD–Micro Perspective: (6 lectures)

Areas of HRD; HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD

Unit 3:Instructional Technology for HRD:(6 lectures)

Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behavior Modeling and Self-Directed Learning; Evaluating the HRD

Unit 4: Human Resource Training and Development: (6 lectures)

Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programs; Role, Responsibilities, and challenges to Training Managers.

Unit 5:Training Methods:(6 lectures)

Training within Industry (TWI): On the Job & Off the Job Training; Management Development: Lecture Method; Role Play; In-basket Exercise; Simulation; Vestibule Training; Management Games; Case Study; Programmed Instruction; Team Development; Globalization challenges and Strategies of Training Program, Review on T&D programs in India.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human resources.

CLO-2: Inculcate cultural and learning skills.

CLO-3: To understand learning methods and their importance.

CLO-4:To understand the need for training.

CLO-5:To develop training methods.

Textbooks:

1. Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi, 2005.
2. Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.
3. Rao, T.V: Readings in HRD, Oxford IBH Pub. Pvt. Ltd., New Delhi, 2004.
4. Aamodt, M.G. (2007) Human/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.

Reference books:

1. Miner J.B. (1992) Organizational Psychology. N Y: McGraw Hill.
2. Virmani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi.

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-	05%
Assignment -2	-	05%
Assessment-3(Mid-Exam)	-	20%
Assignment-3/Quiz-1	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: OEC003

Course Name: Cyber Law & Ethics

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

- To understand Cyber Laws and its evolution in Computer Technologies
- To Understand and analyze Information Technology Act.
- To understand cyber laws and related Legislation.
- To understand electronics business and legal issues associated with it.
- Study based on Cyber crime.

Course Description:

- Write a brief summary indicating how this will be conducted specifying the key topics of the whole course.
- Write about 4 to 5 lines or till 7 lines, if some course description demands.

Course Contents:

UNIT – I

Introduction to Cyber Law Evolution of Computer Technology : Emergence of Cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

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UNIT – II

Information technology Act : Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

UNIT – III

Cyber law and related Legislation : Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

UNIT – IV

Electronic Business and legal issues: Evolution and development in E- commerce, paper vs paper less contracts E-Commerce models- B2B, B2C,E security. **Application area:** Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.

UNIT – V

Case Study On Cyber Crimes: Harassment Via E-Mails, Email Spoofing (Online A Method Of Sending E-Mail Using A False Name Or E-Mail Address To Make It Appear That The E-Mail Comes From Somebody Other Than The True Sender, Cyber Pornography (Exm.MMS),Cyber-Stalking.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to

- CLO-1: Understand the concept of cyber law and it evolution in computer technology
- CLO-2: Understand Information Technology Act in detail.
- CLO-3: Understand cyber laws and related Legislation.
- CLO-4: Relate electronics business with its legal issues associated with cyber laws.
- CLO-5: Understand real problems through case studies based on cyber law incidents.

Text books:

- K.Kumar "Cyber Laws :Intellectual Property & E Commerce Security, Dominant Publisher
- Rondey D. Ryder, Guide to Cyber Laws, Wadhwa & Company, New Delhi.
- Information Security Policy & Implementation Issues, NIIT, PHI.

Reference books:

- Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, Edition, PHI.
- Sharma, S.R., "Dimensions Of Cyber Crime", Annual publications Pvt. Ltd-2004

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106129/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	-	05%
Assignment-2	-	05%
Assessment-3(Midexam)	-	20%
Assignment-3	-	05%
Assignment-4	-	05%
Total Internal Assessment	**-**	**40%**

LIST OF ELECTIVES

Thread 1: Theory & Algorithms		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-T 501	Graph Theory
Elective II	PEC-IT-T 601	Advanced Algorithms
Elective III	PEC-IT-T 602	Parallel & Distributed Algorithms
Elective IV	PEC-IT-T 701	Computational Complexity
Elective V	PEC-IT-T 702	Computational Complexity
Elective VI	PEC-IT-T 703	Queuing Theory & Modeling
Additional Subject (can replace with any elective from the same thread): Theory Of Computation		

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Thread 2: Systems		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-S 501	Advanced Computer Architecture
Elective II	PEC-IT-S 601	Software Engineering
Elective III	PEC-IT-S 602	Distributed Systems
Elective IV	PEC-IT-S 701	Embedded Systems
Elective V	PEC-IT-S 702	Advanced Operating Systems
Elective VI	PEC-IT-S 703	Low Power Circuit & Systems
Additional Subject (can replace with any elective from the same thread): Fault Tolerant Computing		

Thread 3: Data Science & Machine Intelligence		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-D 501	Artificial Intelligence
Elective II	PEC-IT-D 601	Machine Learning
Elective III	PEC-IT-D 602	**Data Mining
Elective IV	PEC-IT-D 701	Soft Computing
Elective V	PEC-IT-D 702	Speech and Natural Language Processing
Elective VI	PEC-IT-D 703	**Data Analytics

Thread 4: Applications		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PEC-IT-A 501	Image Processing
Elective II	PEC-IT-A 601	Digital Signal Processing
Elective III	PEC-IT-A 602	**Cloud Computing
Elective IV	PEC-IT-A 701	Human Computer Interaction
Elective V	PEC-IT-A 702	Electronic Design Automation
Elective VI	PEC-IT-A 703	Computer Graphics

Thread 1: Theory & Algorithms

Course Code: PEC-IT-T 501 **Course Name: Graph Theory**
Course Credit: 3 **Total Contact Hour:** 42 HRS

Course Objective:

Graph Theory is one of the essential tools for learning Technology, Engineering and Sciences. In this course students will come across several theorems and proofs. This course is aimed to cover a variety of different problems in Graph Theory. Theorems will be stated and proved formally using various techniques.

Course Description:

Graph theory is a study of graphs, trees and networks. Topics that will be discussed include Euler formula, Hamilton paths, planar graphs and coloring problem; the use of trees in sorting and prefix codes; useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm

Course Contents:

Unit-I

Predicate Calculus: Proposition, Logical operators and expressions, predicates, Rules of quantifiers. Rules of Inference for propositions and predicates.

Unit-II

Lattices: Relation, Poset, Hasse diagram, Lattice as Poset Properties of lattices, Lattice as an algebraic system, Duality.

Unit-III

Concepts of Graphs and Trees: Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees Spanning and Minimal spanning trees

Unit-IV

Matrix representations and Graph Algorithms: Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs: 1 and 2-isomorphism Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, prims and Kruskal.

Unit-V

Planar graphs and their properties: Planarity of graphs, Planar graphs Stereographic projection and embedding on a sphere Kurtowski's two graphs, Euler's formula, Detection of planarity and elementary reduction

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Apply concept of Predicate Calculus in computer science like design of computing machines, artificial intelligence, definition of data structures for programming languages etc. (Application)
- Understand the concepts of graph theory, Lattices, and Boolean Algebrain analysis of various computer science applications. (Knowledge, Comprehension)
- Apply the knowledge of Boolean algebra in computer science for its wide applicability in switching theory, building basic electronic circuits and design of digital computers. (Knowledge, Application)

Text books:

- Rosen Kenneth: Discrete mathematics and its applications. McGraw hill- New Delhi. 2. Stanat and McAlister: Discrete Mathematics for Computer Science, PHI

Reference books:

- Kolman and R.C. Busby: Discrete mathematical structures for computer science Prantice Hall, New-Delhi.
- J.P. Tremblay and Manohar: Discrete mathematical structures with application to Computer Science, McGraw hill- New Delhi.

Online links for study & reference materials:

https://nptel.ac.in/courses/111/106/111106102/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PEC- CS-T 601 **Course Name:** Advanced Algorithms
Course Credit: 3 **Total Contact Hour:** 42hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description:

This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. There will also be a brief introduction to complexity theory, the formal study of algorithm performance. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Course Contents:

Unit-I

Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis..

Unit-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations,LUP-decomposition

Unit-IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programmingparadigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast FourierTransform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Unit-VI

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyze worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Text books:

- Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. Algorithms. McGraw-Hill, 2006. ISBN: 9780073523408.
- Kleinberg, Jon, and Eva Tardos. Algorithm Design. Addison-Wesley, 2005. ISBN: 9780321295354.

Reference books:

- Even, Shimon. *Graph Algorithms*. Computer Science Press, 1979. ISBN: 9780914894216.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105157/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	-	05%
Assessment-2	-	05%
Assessment-3(Midexam)	-	20%
Assessment-3	-	05%
Assessment-4	-	05%
Total Internal Assessment	**-**	**40%**

Course Code: PEC- CS- T 602 **Course Name:** Parallel & Distributed Algorithms

Course Credit Hour: 3 **Total Contact Hour**: 60hr

Course Objective:

- To learn parallel and distributed algorithms development techniques for shared memory and message passing models.
- To study the main classes of parallel algorithms.
- To study the complexity and correctness models for parallel algorithms.

Course Description:

This course will cover widely used parallel and distributed computing methods, including threaded applications, GPU parallel programming, and datacenter-scale distributed methods such as MapReduce and distributed graph algorithms. We'll study the types of algorithms which work well with these techniques, and have the opportunity to implement some of these algorithms. We'll also look at the types of hardware architectures which have been developed along with these computing methods.

Course Contents:

UNIT-I

Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing

UNIT-II

Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples

UNIT-III

Pipelining- Techniques computing platform, pipeline programs examples

UNIT-IV

Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelist sharing data parallel programming languages and constructs, open MP

UNIT-V

Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms

Course Learning Outcomes (CLOs):

CLO-1: Learn about parallel and distributed computers.
CLO-2: Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library
CLO-3: Analytical modeling and performance of parallel programs
CLO-4: Analyze complex problems with shared memory programming with OpenMP.

Text books:

- Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.

Reference books:

Introduction to Parallel algorithms by Jaja from Pearson, 1992.

Online links for study & reference materials:

https://www.britannica.com/science/computer-science/Parallel-and-distributed-computing

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-IT-T 701 **Course Name: Computational Complexity**
Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

Computational complexity theory is the fundamental subject of classifying computational problems based on their complexities'. In this context, `complexity' of a problem is a measure of the amount of resources

Course Description:

Computational complexity aims to understand the fundamental limitations and capabilities of efficient computation. We will use the powerful notions of reduction and completeness to establish relationships between seemingly unrelated problems, classes, and resources.

Course Contents:

Unit-I

Introduction: Easy and hard problems. Algorithms and complexity. Turing machines: Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems

Unit-II

The Halting Problem and Undecidable Languages: Counting and diagonalization. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem. Deterministic Complexity Classes: DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability.

Unit-III

NP and NP-completeness: Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NP-completeness. Cook-Levin Theorem. Polynomial transformations: 3- satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.

Unit-IV

Space complexity and hierarchy theorems: DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NLcompleteness. NL=coNL. Hierarchy theorems

Unit-V

Optimization and approximation: Combinatorial optimization problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, traveling salesman problem, minimum partition.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Determine whether a problem is computable, and prove that some problems are not computable
- Categorize problems into appropriate complexity classes
- Classify problems based on their computational complexity using reductions
- Analyze optimization problems using the concept of interactive proofs

Text books:

- Michael Sipser, Introduction to the Theory of Computation, (First edition - PWS Publishing Company, January 1997, or second edition - Thomson Course Technology, 2005).
- Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press,2009

Reference books:

- Oded Goldreich, Computational Complexity, Cambridge University press, 2008.
- Vijay Vazirani, Approximation Algorithms, Springer--Verlag, 2001

Online links for study & reference materials:

https://nptel.ac.in/courses/106/106/106106229/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-T 703

Course Name: Queuing Theory & Modeling

Course Credit: 3

Total Contact Hour: 40

Course Objective:

The objective of a queuing model is to find out the optimum service rate and the number of servers so that the average cost of being in queuing system and the cost of service are minimized. The queuing problem is identified by the presence of a group of customers who arrive randomly to receive some service.

Course Description:

This course deals with the modeling and analysis of queuing systems, with applications in communications, manufacturing, computers, call centers, service industries and transportation. Topics include birth-death processes and simple Markovian queues, networks of queues and product form networks

Course Contents:

Unit-I

Queueing Theory: Introduction of the queuing system, Various components of a queueing system. Permutations, combinations,

Unit-II

counting, summation, generating function, recurrence relations, asymptotic. Sample space and events- Probability- The axioms of probability

Unit-III

Queuing theory- Classification, stationary process, markov process, Binomial process, Poisson process, Birth and death process, Markov chain.

Unit-IV

Markovian and non-Markovian queueing systems, embedded Markov chain applications to M/G/1, G/M/1 and related queueing systems; Networks of queues, open and closed queueing networks; Queues with vacations,

Unit-V

Priority queues, queues with modulated arrival process, discrete time queues, introduction to matrix-geometric methods, applications in manufacturing, computer and communication networks.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Single Server Markov Queues.
- Rigorous understanding of the theoretical background of queuing systems.
- Introduction to Queuing Systems and Notation.
- Understand and compute quantitative metrics of performance for queuing systems.
- Apply and extend queuing models to analyze real world systems.

Text books:

- D. Gross and C. Harris, Fundamentals of Queueing Theory, 3rd Edition, Wiley, 1998. (WSE Edition, 2004).
- J. Medhi, Stochastic Models in Queueing Theory, 2nd Edition, Academic Press, 2003. (Elsevier India Edition, 2006).

Reference books:

- Saaty, T.L. (1984): Elements of Queueing Theory with applications, McGraw Hill, New York.
- Jain, J.L., Mohanty, S.G. and Bohm, W. (2006): A Course on Queueing Models, Chapman & Hall/CRC.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/103/117103017/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Thread 2: Systems

Course Code: PEC-IT-S 501 **Course Name: Advanced Computer Architecture**
Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

- Understand the Concept of Parallel Processing and its applications.
- Implement the Hardware for Arithmetic Operations.
- Analyze the performance of different scalar Computers.

Course Description:

This course is a study of the fundamental concepts in the design and organization of modern computer systems. The module aims to provide students with a fundamental knowledge of computer hardware and computer systems, with an emphasis on system design and performance.

Course Contents:

Unit-I

Pipeline and vector processing : Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

Unit-II

Computer Arithmetic : Addition and Subtraction, Hardware Implementation, Multiplication Algorithms and Hardware Implementation, Division Algorithms and Hardware Implementation, Floating Point Arithmetic Operations.

Unit-III

Parallel Computer Models : Evolution of Computer Architecture, System Attributes to Performance, Shared Memory Multiprocessors, Distributed Memory Multicomputers, Vector Super Computers, SIMD Super Computers.

Unit-IV

Processors and Memory Hierarchy : Advanced Processor Technology: Design Space of Processors, Instruction-Set Architectures, CISC scalar Processors, RISC scalar Processors, Super Scalar and Vector Processors: Superscalar Processors.

Unit-V

Pipelining and Superscalar Techniques : Linear Pipeline Processors: Asynchronous and Synchronous models, Clocking and Timing Control, Speedup, Efficiency and Throughput, Pipeline Schedule Optimization, Instruction Pipeline Design: Instruction Execution Phases, Mechanisms for Instruction Pipelining, Dynamic Instruction Scheduling, Branch Handling Techniques.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the Concept of Parallel Processing and its applications
- Implement the Hardware for Arithmetic Operations
- Analyze the performance of different scalar Computers
- Develop the Pipelining Concept for a given set of Instructions

Text books:

- Computer System Architecture, Morris M. Mano, 3rd edition, Pearson/Prentice Hall India.
- Advanced Computer Architecture, Kai Hwang, McGraw-Hill, India.

Reference books:

- Computer Organization and Achitecture, William Stallings ,8th edition,PHI
- Computer Organization, Carl Hamachar, Vranesic,Zaky, 5th edition, McGraw Hill.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102229/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-S 601 **Course Name: Software Engineering**
Course Credit: 3 **Total Contact Hour:** 42HRS

Course Objective:

- To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
- To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Description:

The basic objective of software engineering is to develop methods and procedures for software development that can scale up for large systems and that can be used consistently to produce high-quality software at low cost and with a small cycle of time.

Course Contents:

Unit-I

Introduction to Software Engineering, Software Components, 8 Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative

Unit-II

Software Requirement Specifications (SRS)

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document.

Unit-III

Software Design: Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Unit-IV

Software Testing:Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies:

Unit-V

Software Maintenance and Software Project Management 8 Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO)

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Students will be able to decompose the given project in various phases of a lifecycle.
- Students will be able to choose appropriate process model depending on the user requirements
- Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance
- Students will be able to know various processes used in all the phases of the product.

Text books:

- R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
- Rajib Mall, Fundamentals of Software Engineering, PHI Publication.

Reference books:

- K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
- Pankaj Jalote, Software Engineering, Wiley
- Deepak Jain,”Software Engineering:Principles and Practices”,Oxford University Press

.**Online links for study & reference materials:**

https://nptel.ac.in/courses/106/105/106105182/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-S 602

Course Name: Distributed Systems

Course Credit Hour: 3

Total Contact Hour: 40hr

Course Objective:

To provide hardware and software issues in modern distributed systems.

- To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

- To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Course Description: This course provides a hands-on the challenges faced in constructing client/server software: partial system failures, multiple address spaces, absence of a single clock, latency of communication, heterogeneity, absence of a trusted operating system, system management, binding and naming. Techniques for meeting these challenges: RPC and middleware, naming and directory services, distributed transaction processing, 'thin' clients, data replication, cryptographic security, mobile code. Introduction to Java RMI.

Course Contents:

Unit I

Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. TheoreticalFoundation for Distributed System: Limitation of Distributed system, absence of global clock,shared memory, Logical clocks, Lamport's& vectors logical clocks. Concepts in Message PassingSystems: causal order, total order, total causal order, Techniques for Message Ordering, Causalordering of messages, global state, termination detection.

Unit II

Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement ofmutualexclusion theorem, Token based and non-token-based algorithms, performance metric fordistributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resourceVs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralizeddead lock detection, distributed dead lock detection, path pushing algorithms, edge chasingalgorithms.

Unit III

Agreement Protocols: Introduction, System models, classification of Agreement Problem,Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution toByzantine Agreement problem, Application of Agreement problem, Atomic Commit in DistributedDatabase system. Distributed Resource Management: Issues in distributed File Systems,Mechanism for building distributed file systems, Design issues in Distributed Shared Memory,Algorithm for Implementation of Distributed Shared Memory.

Unit IV

Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems.Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Unit V

Transactions and Concurrency Control: Transactions, Nested transactions, Locks, OptimisticConcurrency control, Timestamp ordering, Comparison of methods for concurrency control.Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Course Learning Outcomes (CLOs):

CO1: To provide hardware and software issues in modern distributed systems.

CO2: To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3: To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

CO4: To know about Shared Memory Techniques.

CO5: Have Sufficient knowledge about file access.

Text books:

1. Singhal&Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill

2. Ramakrishna,Gehrke," Database Management Systems", McGraw Hill

3. Vijay K.Garg Elements of Distributed Compuitng , Wiley

4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", PearsonEducation

5. Tenanuanbaum,Steen," Distributed Systems", PHI

Reference books:

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.

2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor &Fransis Group, 2007.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-IT-S 701 **Course Name: Embedded Systems**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

- To provide an overview of Design Principles of Embedded System.
- To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Description :

In this course you will learn the basics of designing, interfacing, configuring, and programming embedded systems. By the end of the course you will have mastered the basics of embedded system design and programming. This course will help to prepare you for cutting edge careers in industry and research.

Course Contents :

Unit 1
Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit 2
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit 3
Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit 4
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Unit 5
Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Course Learning Outcomes (CLOs) :

- CLO1: Expected to understand the selection procedure of Processors in the Embedded domain.
- CLO2: Design Procedure for Embedded Firmware.
- CLO 3: Expected to visualize the role of Real time Operating Systems in Embedded Systems
- CLO 4. Expected to evaluate the Correlation between task synchronization and latency issues

Text books:

- Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference books:

- Embedded Systems - Raj Kamal, TMH.
- Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
- Embedded Systems – Lyla, Pearson, 2013
- An Embedded Software Primer - David E. Simon, Pearson Education.

Online links for study & reference materials :

https://nptel.ac.in/courses/108/102/108102045/
https://nptel.ac.in/courses/106/105/106105193/

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-S 702 **Course Name :** Advanced Operating System

Course Credit Hour : 3 **Total Contact Hour :** 30hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

ModuleI FUNDAMENTALS OF OPERATING SYSTEMS

Overview –Synchronization Mechanisms , Processes and Threads , Process Scheduling , Deadlocks: Detection, Prevention and Recovery, Models of Resources, Memory Management Techniques.

ModuleII DISTRIBUTED OPERATING SYSTEMS

Issues in Distributed Operating System , Architecture , Communication Primitives , Lamport's Logical clocks, Causal Ordering of Messages, Distributed Mutual Exclusion Algorithms, Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols.

ModuleIII DISTRIBUTED RESOURCE MANAGEMENT

Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery, Fault Tolerance , Two-Phase Commit Protocol, Non blocking Commit Protocol , Security and Protection.

ModuleIV REAL TIME AND MOBILE OPERATING SYSTEMS

Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems , Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management , File system.

ModuleV CASE STUDIES

Linux System: Design Principles , Kernel Modules, Process Management Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication. iOS and Android: Architecture and SDK Framework , Media Layer, Services Layer, Core OS Layer, File System.

Course Learning Outcomes (CLOs):

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.

4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Text books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-S 703 **Course Name:** Low Power Circuit & Systems
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To learn fundamentals of power dissipation in microelectronic devices.
- To identify system performance and reliability

Course Description:

This course deals with issues and models to design low-power VLSI circuits, fundamentals of power dissipation in microelectronic devices, will be able to estimate power dissipation due to switching, short circuit.

Course Contents:

Unit 1

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degreeoffreedom, recurring themes in low-power, emerging low power approaches, dynamicdissipation in CMOS, effects of Vdd& Vt on speed, constraints on Vt reduction, transistorsizing & optimal gate oxide thickness, impact of technology scaling, technologyinnovations.

Unit 2

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, highcapacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3

Low Power Clock Distribution: Power dissipation in clock distribution, single driverversusdistributed buffers, buffers & device sizing under process variations, zero skew vs.tolerableskew, chip & package co-design of clock network.

Unit 4

Logic Synthesis for Low Power estimation techniques: Power minimization techniques,lowpower arithmetic components- circuit design styles, adders, multipliers.

Unit 5

Low Power Memory Design: Sources & reduction of power dissipation in memorysubsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits,low power SRAM circuits.

Unit 6

Low Power Microprocessor Design System: power management support, architecturaltradeoffs for power, choosing the supply voltage, low-power clocking, implementation problemfor low power, comparison of microprocessors for power & performance.

Course Learning Outcomes (CLOs) :

At the end of this course students will demonstrate the ability to

- Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
- Characterize and model power consumption & understand the basic analysis methods.
- Understand leakage sources and reduction techniques.

Text books:

- Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

Reference books:

- P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002
- Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons Inc.,2000.
- J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
- A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995

Online links for study & reference materials:
https://nptel.ac.in/courses/117/101/117101004/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Thread 3: Data Science & Machine Intelligence

Course Code: PEC-IT-D 501

Course Name : Artificial Intelligence

Course Credit Hour: 3

Total Contact Hour : 42hr

Course Objective: The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environments.

Course Description: Artificial intelligence (AI) is a research field that studies how to realize the **intelligent** human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously.

Course Contents:

Module 1: Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Module II: Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games,Alpha - Beta pruning.

Module III: Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Module IV: Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning,

Module V: Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

Course Learning Outcomes (CLOs):

1) Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

2) Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

3) Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

4) Demonstrate profciency developing applications in an 'AI language', expert system shell, or data mining tool.

5) Demonstrate profciency in applying scientifc method to models of machine learning.

6) Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

Text books :

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”,McGraw-Hill
2. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, PearsonEducation Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall ofIndia,

Reference books :

1. A Modern Approach Third Edition Stuart Russell and Peter Norvig, 2010. Pearson Education, Inc. ISBN: 978-0-13-604259-4
2. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, PearsonEducation

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-D601 **Course Name:** Machine Learning

Course Credit Hour: 3hr **Total Contact Hour:** 40hr

Course Objective:

- The course aims to provide basic understanding of issues and challenges of Machine Learning. It aims to train the student to the basic and advanced models and algorithms of the core field of machine learning. This course also involves understanding of the strengths and weaknesses of many popular machine learning approaches.

Course Description:

- The course covers the basic concepts and techniques of Machine Learning from both theoretical and practical perspective. The material includes Introduction to machine learning and different types of learning, Linear Regression, Decision Trees, Instance based learning, Feature Selection, Neural Network, Clustering and Support Vector Machines. The students will be able to understand almost all algorithms required to develop ML applications.

Course Contents:

Unit-1: Introduction to machine learning and different types of learning: Brief Introduction to Machine Learning; Definition, Components of a learning problem, Applications, Choosing a Model Representation, Types of learning: Supervised Learning, Unsupervised Learning, Semi-supervised learning, Reinforcement Learning, Inductive Learning or Prediction,

Unit-2: Linear Regression and Decision Trees, Instance based learning and Feature Selection: Regression, Types of Regression Models (Linear Classification, Logistic Regression, Components Regression, Bias – Variance Linear Regression Multivariate Regression etc), Dimensionality Reduction Subset Selection, Shrinkage Methods, Principle Linear Discriminant Analysis Optimization, Classification- Separating Hyperplanes Classification, LMS Algorithm, Decision Tree, Over fitting, Instance- Based Learning, Basic k-nearest neighbor classification, kNN, Euclidean Distance, Feature Reduction in ML, Subset selection, Feature extraction, PCA

Unit-3: Probability and Bayes Learning, Support Vector Machines, Clustering: Probability for Learning, Bayes Theorem, MAP Learner, Naïve Bayes, Bayesian Network, Logistic Regression for classification, Support Vector Machines, Unsupervised learning, Partitioning Algorithms, Hierarchical Clustering, Density based Clustering, K-means algorithm.

Unit-4: Neural Network: Neuron, ANNs, Perceptrons, Gradient Descent, Early models, Back propagation, Initialization, Training & Validation, Parameter Estimation (Maximum Likelihood Estimation, Bayesian Parameter Estimation) Decision Trees Evaluation Measures, Hypothesis Testing Ensemble Methods, Graphical, Deep Learning, Deep Neural Network, Hierarchical Representation, Unsupervised Pre-training, Activation Functions.

Unit-5: Clustering, Gaussian Mixture Models, Spectral Clustering Ensemble Methods Learning Theory, Reinforcement Learning.

Course Learning Outcomes (CLOs):

On completion of the course students will be expected to

- **CLO-1**: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity etc,

- **CLO-2**: Have an understanding of the strength and weaknesses of many popular machine learning approaches.
- **CLO-3**: Appreciate the underlying mathematical relationship within and across Machine Learning Algorithms and the paradigm of supervised and un-supervised learning.
- **CLO-4**: Be able to design various machine learning algorithms in a range of real world applications.

Text books:

- Alpaydin E, Machine Learning, MIT Press.
- Bishop C, Pattern Recognition and Machine Learning, Springer-2006.
- Duda R, Hart E and Stork D, Pattern Classification, Wiley-Interscience.
- Mitchell T, Machine Learning, McGraw-Hill.

Reference books:

- Hastie T, Tibshirani R and Friedman J, Elements of Statistical Learning, Springer-2017.
- T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,
- Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Online links for study & reference materials:

https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-D 602 **Course Name:** Data Mining

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To identify the scope and essentiality of Data Mining.
- To analyze data, choose relevant models and algorithms for respective applications.
- To study spatial and web data mining.
- To develop research interest towards advances in data mining.

Course Description:

- Data mining refers to a set of techniques that have been designed to efficiently find interesting pieces of information or knowledge in large amounts of data.
- In this course we explore how this interdisciplinary field brings together techniques from databases, statistics, machine learning, and information retrieval

Course Contents:

Module 1: **FUNDAMENTALS:** Relation to Statistics – Databases – Data Mining Functionalities – Steps in Data Mining Process– Architecture of Typical Data Mining Systems –Classification of Data Mining Systems– Overview of Data Mining Techniques.

Module 2: DATA PREPROCESSING AND ASSOCIATION RULES

Data Preprocessing – Data Cleaning – Integration – Transformation – Reduction –Discretization Concept Hierarchies – Concept Description Data Generalization and Summarization Based Characterization – Mining Association Rules in Large Databases.

Module 3: PREDICTIVE MODELING

Classification and Prediction Issues Regarding Classification and Prediction –Classification by Decision Tree Induction – Bayesian Classification – Other Classification Methods– Prediction –Clusters Analysis – Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods.

Module 4: DATA WAREHOUSING

Data Warehousing Components – Multi Dimensional Data Model – Data Warehouse Architecture – Data Warehouse Implementation – Mapping the Data Warehouse to Multiprocessor Architecture – OLAP – Need – Categorization of OLAP Tools.

Course learning outcomes:

- Understand Data Mining data warehouse Principles
- Identify appropriate data mining algorithms to solve real world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Describe complex data types with respect to spatial and web mining.
- Benefit the user experiences towards research and innovation. integration.

Suggested books:

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers, 2002.

Suggested reference books:

1. Alex Berson, Stephen J Smith, “Data Warehousing, Data Mining & OLAP”, Tata Mcgraw Hill, 2004.

2. Usama M. Fayyad, Gregory Piatetsky , Shapiro, Padhrai Smyth and Ramasamy Uthurusamy," Advances In Knowledge Discovery And Data Mining", The M.I.T Press, 1996.

3. Ralph Kimball, "The Data Warehouse Life Cycle Toolkit", John Wiley& Sons Inc., 1998.

4. Sean Kelly, "Data Warehousing In Action", John Wiley & Sons Inc., 1997.

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-D 701 **Course Name:** Soft Computing

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

1. To make the student to understand the role of imprecision and uncertainty in real world scenarios.
2. To explain the role of Soft Computing in addressing the imprecision and uncertainty.
3. To explain the principal components of soft computing that include Fuzzy Sets and Fuzzy Logic, Artificial Neural Networks, Genetic Algorithms and Rough Sets.
4. To learn the Design and Implementation of Soft Computing methodologies.
5. To explain the design of hybrid systems which is combination of one or more soft computing methodologies mentioned.

Course Description:

This **course** will provide students the basic concepts of different methods and tools for processing of uncertainty in intelligent systems, such as, **fuzzy** models, **neural networks**, probabilistic models, and foundations of its using in real systems.

Course Contents:

Module 1 Soft Computing: Introduction to Fuzzy Computing, Neural Computing, GeneticAlgorithms, Associative Memory, Adaptive Resonance Theory, Different Tools and Techniques,Usefulness andApplications.

Module 2. Fuzzy Sets and Fuzzy Logic: Introduction, Fuzzy Sets Versus Crisp Sets, Operations on FuzzySets, Extension Principle, Fuzzy Relations and Relation Equations, Fuzzy Numbers, LinguisticVariables, Fuzzy Logic, Linguistic Hedges,Applications,

Module 3. Interference in fuzzy logic: fuzzy if-then rules, Fuzzy implications and Fuzzyalgorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Fuzzy Controllers, FuzzyPattern Recognition, Fuzzy Image Processing, Fuzzy Database. **Artificial Neural Network**: Introduction, Artificial Neuron and its model, activationfunctions, Neural network architecture: single layer and multilayer feed forward networks,re-current networks. Various learning techniques, perception and convergence rule, Auto-associativeand hetro-associative memory , Hebb's Learning, Adaline,Perceptron

Module 4. Multilayer Feed Forward Network: Back Propagation Algorithms, Different IssuesRegarding Convergence of Multilayer Perceptron, Competitive Learning, Self- Organizing, FeatureMaps, Adaptive Resonance Theory, Associative Memories,Applications. **Evolutionary and Stochastic Techniques:** Genetic Algorithm (GA), GeneticRepresentations, (Encoding) Initialization and Selection, Different Operators of GA, Analysis ofSelection Operations, Hypothesis of Building Blocks, Schema Theorem and Convergence ofGenetic Algorithm, Simulated Annealing and Stochastic Models, Boltzmann Machine,Applications.

Module 5. Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reductionof Knowledge, Decision Tables and Applications. Hybrid Systems: Neural- Network-BasedFuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Designand Learning, Fuzzy Logic and Genetic Algorithm for Optimization,Applications

Course learning outcomes:

1. Ability to represent Uncertainty / imprecision data.
2. Ability to select a suitable method of Soft Computing to solve a particular problem.

3. Ability to build hybrid systems using Soft Computing techniques.

TextBooks:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, S.Rajsekar an and G.A. Vijayalakshmi Pai, Prentice Hall ofIndia.
2. Rough Sets, Z.Pawlak, Kluwer Academic Publisher,1991.
3. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher,1997

References:

1. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
2. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice HallPTR. Addison-Wesley
3. Learning and Soft Computing, V. Kecman, MIT Press,2001
4. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI,1997

Online links for study & reference materials:

1. NPTEL

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-D 702

Course Name: Speech & Natural Language Processing

Course Credit Hour: 3hr

Total Contact Hour: 42hr

Course Objective: This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Course Description: **NLP** tasks in syntax, semantics, and pragmatics. Applications such as **information** extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning.

Course Contents:

Module I Introduction: Knowledge in speech and language processing, Ambiguity, Models and Algorithms, Brief History Regular Expressions and Automata: Regular Expressions, Finite-State Automata, Regular Languages and FSA Morphology and Transducers: Inflectional and derivational morphology, finite state morphological parsing, Combining FST Lexicon and rules. Lexicon free FST: Porter Stemmer N-grams: Counting Words in Corpora, SIMPLE (UNSMOOTHED) N-GRAMS, Smoothing, Entropy HMM and Speech Recognition: Speech Recognition Architecture, Overview of HMM, A* decoding .

Module II Word Classes and Part-of-Speech Tagging: English word classes, Targets for English, Part of speech Tagging, Rule Based part of speech Tagging, Transformation Based Tagging. Context Free Grammars for English: Constituency, Context Free rules and Trees, Sentence level construction, The Noun Phrase, Coordination, Agreement, The verb phrase and sub-categorization. Spoken Language Syntax, Grammar Equivalence and Normal form, Finite state context free grammars, Grammar and human processing. Parsing with context free grammars: Parsing as Search, Basic Top down Parser, Problems with basic top-down-parsers, the early Algorithm, Finite state parsing method Features and Unifications: Feature structures, Unification of Features Structures, Features Structures in the grammar, Implementing Unification. Lexicalized and probabilistic parsing: Probabilistic context free grammars, problems with probabilistic context free grammars, probabilistic lexicalized GFG.

Module III Semantics Representing Meaning: Computational Desiderata for representation, Meaning structure of language, First order predicate calculus, linguistically relevant concept, Related Re-presentational approaches, Alternative approaches to meaning. Semantic Analysis: Syntax driven semantic analysis, Attachment of Fragment of English, Integrating semantic analysis with early parser. Robust Semantic Analysis. Lexical Semantics: Relation among lexemes and their senses, Internal Structure of words.

Module IV Pragmatics Discourse: Reference resolution, Text Coherence, Discourse Structure, Psycholinguistics Studies of reference and coherence. Natural Language generation: Introduction to language generation, Architecture for generation, Surface realization, Discourse planning, Macro planning, Lexical selection, evaluating generation systems, generating speech

Course learning outcomes:

After successful completion of this course, student will be able to

1. Understand approaches to syntax and semantics in NLP.
2. Understand approaches to discourse, generation, dialogue and summarization within NLP.
3. Understand current methods for statistical approaches to machine translation.
4. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods, log-linear and discriminative models, and the EM algorithm as applied within NLP

Text books:

1. Speech and Language processing An introduction to Natural Language Processing, Computational Linguistics and speech Recognition by Daniel Jurafsky and James H. Martin (ISBN13: 978-0131873216)
2. 2. Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Lopper(ISBN13:978-0596516499)

Reference book:

1. Handbook of Natural Language Processing, Second Edition—NitinIndurkhya, Fred J. Damerau, Fred J. Damerau (ISBN13: 978-1420085921)

Online links for study & reference materials:

1. **NPTEL**

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-D 703 **Course Name:** Data Analytics

Course Credit Hour: 3hr **Total Contact Hour:** 42hr

Course Objective:

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSqlMapReduce.
- To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Description:

- This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to make decisions on operations, risk management, finance, marketing, etc.
- Analysis is done targeting economic and financial decisions in complex systems that involve multiple partners. Topics include probability, statistics, hypothesis testing, regression, clustering, decision trees, and forecasting.

Course Contents:

Module 1: Big Data and its Importance– Four V's of BigData– DriversforBigData– IntroductiontoBigDataAnalytics– BigDataAnalyticsapplications, Hadoop's Parallel World–Data discovery Opensourcetechnology for Big Data Analytics–cloud and Big Data–PredictiveAnalytics– MobileBusinessIntelligenceandBigData–CrowdSourcing Analytics–Inter-andTrans-FirewallAnalytics-InformationManagement.

Module2: Integratingdisparatedatastores-Mappingdatatotheprogrammingframework- Connecting and extracting data from storage -Transforming data for processing – SubdividingdatainpreparationforHadoopMapReduce, Hadoop Map Reduce-Creating the componentsofHadoop.

Module3: MapReducejobs-Distributingdataprocessingacrossserverfarms-Executing HadoopMapReducejobs-Monitoringtheprogressofjobflows-TheBuildingBlocksof Hadoop Map Reduce - Distinguishing Hadoop daemons-Investigating the HadoopDistributedFileSystem Selectingappropriateexecutionmodes:local,pseudo-distributed,Fullydistributed.

Module 4: Real-TimeArchitecture–OrchestrationandSynthesisUsingAnalyticsEngines– Discovery using Data atRest– Implementation of Big Data Analytics – Big Data Convergence– AnalyticsBusinessMaturityModel,InstallingandRunningPig–Comparison with Databases–Pig Latin UserDefineFunctions–Data Processing Operators–Installing andRunningHive–HiveQL–Tables– QueryingData–User-DefinedFunctions–Oracle BigData.

Course learning outcomes:

- Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
- Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
- Interpret business models and scientific computing paradigms, and apply software tools for big data analytics.

- Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Suggested books:

1. Data Mining and Business Analytics with R, by Johannes Ledolter; Publisher: Wiley (2013), ISBN-13: 978-1118447147;
2. An Introduction to Statistical Learning with Application in R, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani;Publisher: Springer (2013); ISBN-13: 978-1461471370;

Suggested reference books:

1.MichaelMinelli,Michehe Chambers,"Big Data,Big Analytics: Emerging Business IntelligenceandAnalyticTrendsforToday'sBusiness",1stEdition,AmbigaDhiraj,WielyCIO Series,2013.
2.ArvindSathi,"BigDataAnalytics:DisruptiveTechnologiesforChangingtheGame", 1stEdition,IBMCorporation,2012.
3.BillFranks,"TamingtheBigDataTidalWave:Finding Opportunities in Huge Data Streams withAdvancedAnalytics",1stEdition,WileyandSASBusinessSeries,2012.
4.Tom White,"Hadoop:TheDefinitiveGuide",3rdEdition,O'reilly,2012.

Online links for study & reference materials:

1. https://catalyst.library.jhu.edu/catalog/bib_6591386
2. https://catalyst.library.jhu.edu/catalog/bib_4637122

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Thread 4: Applications

Course Code : PEC- CS-A 501 **Course Name:** Image Processing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the need for image transforms different types of image transforms and their properties.
- To develop any image processing application.
- To understand the rapid advances in Machine vision.
- To learn different techniques employed for the enhancement of images.

Course Description:

This course will cover the fundamentals of image processing. We will provide a mathematical framework to describe and analyze images as two- and three-dimensional signals in the spatial, spatio-temporal, and frequency domains. In this class not only will you learn the theory behind fundamental processing tasks including image/video enhancement, recovery, and compression – but you will also learn how to perform these key processing tasks in practice using state-of-the-art techniques and tools. We will introduce and use a wide variety of such tools – from optimization toolboxes to statistical techniques.

Course Contents:

UNIT 1

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

UNIT 2

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT 3

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

UNIY 4

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

UNIT 5

Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding

Text books:

- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
- Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Reference books:

- Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Online links for study & reference materials:

https://nptel.ac.in/courses/117/105/117105079/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-A601 **Course Name:** Digital Signal Processing
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To develop a thorough understanding of the central elements of discrete time signal processing theory and the ability to apply this theory to real-world signal processing applications.
- Use z-transforms and discrete time Fourier transforms to analyze a digital system.
- Understand the discrete Fourier transform (DFT), its applications and its implementation by FFT techniques.
- Design and understand finite & infinite impulse response filters for various applications.

Course Description:

The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.

Course Contents:

Unit 1

Discrete time signals: Sequences; representation of signals on orthogonal basis; Samplingand reconstruction of signals; Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequencyAnalysis, Inverse Systems, Discrete Fourier Transform (DFT),Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit 2

Designof FIR Digital filters: Windowmethod,Park-McClellan's method.Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Lowpass, Bandpass, Bandstop and High pass filters.

Unit 3

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit 4

Introduction to multiratesignalprocessing, Application of DSP.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications

Text books:

- S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Edition IV**.**

Reference books:

- A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
- John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
- L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/105/108105055/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-A 602

Course Name: Cloud Computing

Course Credit Hour: 3

Total Contact Hour: 42hr

Course Objective:

- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their importance

Course Description: This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Business Process as a Service (BPaaS). IaaS topics start with a detailed study the evolution of infrastructure migration approaches from VMWare/Xen/KVM virtualization, to adaptive virtualization, and Cloud Computing / on-demand resources provisioning.

Course Contents:

Unit I

INTRODUCTION

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing –Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity inCloud – On-demand Provisioning.

Unit II

CLOUD ENABLING TECHNOLOGIES

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels ofVirtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices –Virtualization Support and Disaster Recovery.

Unit III

CLOUD ARCHITECTURE, SERVICES AND STORAGE

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public,

Private and Hybrid Clouds – laaS – PaaS – SaaS – Architectural Design Challenges – CloudStorage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

Unit IV

RESOURCE MANAGEMENT AND SECURITY IN CLOUD

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods

Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

Unit V

CLOUD TECHNOLOGIES AND ADVANCEMENTS

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment forGoogle App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.

Course Learning Outcomes (CLOs):

CO1: Understand the fundamental principles of distributed computing.

CO2: Understand how the distributed computing environments known as Grids can be built from lower-level services.

CO3: Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.

CO4: Analyze the performance of Cloud Computing.

CO5: Understand the concept of Cloud Security.

Text books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to theInternet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security,CRC Press, 2017.

3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.

5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud:

Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Reference books:

1. Barrie Sosinsky: "Cloud Computing Bible", Wiley-India, 2010
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms", Wiley, 2011
3. Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", Springer, 2012
4. Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
5. Tim Mather, Subra Kumara swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media, 2009.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

Course Code: PEC-IT-A 701

Course Name: Human Computer interaction

Course Credit Hour: 4hr

Total Contact Hour: 60hr

Course Objective:

- Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
- Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

- Write a brief summary indicating how this will be conducted specifying the key topics of the whole course.
- Write about 4 to 5 lines or till 7 lines, if some course description demands.

Course Contents:

Unit 1

Introduction: Importance of user Interface – definition, importance of 8 good design. Benefits ofgood design. A brief history of Screen design. The graphical user interface – popularity of graphics,theconceptofdirectmanipulation,graphicalsystem,Characteristics,Webuser–Interfacepopularity,characteristics-Principlesofuserinterface

Unit 2

Designprocess: Human interaction with computers, importance of 8 human characteristics human consideration,Humaninteractionspeeds,understandingbusinessjunctions.IIIScreenDesigning:Designgoals – Scre

Unit 3

ScreenDesigning: Designgoals–Screenplanningandpurpose,8organizingscreenelements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition –amount of information – focus and emphasis – presentation information simply and meaningfully – informationretrievalonweb–statisticalgraphics–Technologicalconsiderationininterfacedesign.

Unit 4

Windows: New and Navigation schemes selection of window, 8 selection of devices based andscreen based controls. Components – text and messages, Icons and increases – Multimedia, colors,usesproblems, choosingcolors

Unit 5

Softwaretools: Specificationmethods,interface–BuildingTools.8InteractionDevices–Keyboardandfunctionkeys–pointingdevices–speechrecognitiondigitizationandgeneration–image and video displays –drivers.

Course Learning Outcomes (CLOs):

Understand fundamental design and evaluation methodologies of human computer interaction. Demonstrate knowledge of human computer interaction design concepts and related methodologies.

Apply theories and concepts associated with effective work design to real-world application

Text books:

1. AlanDix,JanetFinlay,GregoryAbowd,RussellBealeHumanComputer Interaction,3rdEditionPrenticeHall,2004.
2. JonathanLazarJinjuanHeidiFeng,HarryHochheiser,ResearchMethodsinHumanComputerInteraction,Wiley,2010.
3. BenShneidermanandCatherinePlaisantDesigningtheUserInterface:StrategiesforEffectiveHuman-ComputerInteraction(5thEdition,pp.672,ISBN0-321-53735-1,March2009),Reading,MA:Addison-WesleyPublishingCo.

Reference books:

"Human-Computer Interaction" by Dix

"Designing the User Interface: Strategies for Effective Human-Computer Interaction" by Shneiderman

Online links for study & reference materials:

https://guides.lib.uw.edu/research/hcid/hcid-rec

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : PEC-IT-A 702 **Course Name:** ELECTRONIC DESIGN AUTOMATION
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective :

To describe both simple and complex RTL design scenarios using VHDL/verilog. It gives practical information on the issues in ASIC prototyping using FPGAs, design challenges and how to overcome practical issues and concerns.

Course Description :

With this course the students will able to understand the concept of simulation &sysnthesis of complex circuits using VHDL/VERILOG.

Course Contents :

Unit1

Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.

Unit 2

Design entry by Verilog/VHDL/FSM, Verilog AMS.

Unit 3

Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.

Unit 4

Design for performance, Low power VLSI design techniques. Design for testability.

Unit 5

IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping

Unit 6

Case studies and Speed issues.

Course Learning Outcomes(CLOs) :

CO1: Describe Finite State Machines and comprehend concepts of clock related issues.

CO2: Model digital circuits using Verilog and understand the concepts of analog and mixed signal Systems design using Verilog AMS.

CO3: Outline the concepts of different design flows in VLSI.

CO4: Illustrate different low power latches and Flip-flops.

CO5: Explain the concepts of IP cores and Prototyping.

Text books :

- Richard S. Sandige, Modern Digital Design , MGH, International Editions,1990
- T. R. Padmanabhan and B. F.V.G. Bala Tripura Sundari, Design through Verilog HDL , WSE, IEEE Press, 2004.
- Zeidman, Bob. Designing with FPGAS and CPLDS . CRC Press, 2002.
- KiatSeng Yeo, Samir S. Rofail, Wang-Ling Goh, CMOS/Bi CMOS ULSI Low Voltage Low Power , Pearson Education Asia 1st Indian reprint, 2002.
- Doug Amos, Austin Lesea, Rene Richter, FPGA based prototyping methodology manual , Xilinx.

Reference books :

- Palnitkar, Samir. Verilog HDL: a guide to digital design and synthesis . Pearson Education India, 2003.
- Givone, Donald D. Digital principles and design . Palgrave Macmillan, 2003.
- Roth, Charles H. Digital systems design using VHDL . Wadsworth Publ. Co., 1998.

Online links for study & reference materials :

http://smdpc2sd.gov.in/downloads/IEP/IEP%208/24-02-18%20Rejender%20pratap.pdf
https://inst.eecs.berkeley.edu/~cs150/sp02/useful_files/Synthesis_Simulation_Design_Guide.pdf

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-IT-A 703 **Course Name:** Computer Graphics

Course Credit Hour: 3 **Total Contact Hour**: 40hr

Course Objective:

 Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.

 Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

Basic principles and techniques for computer graphics on modern graphics hardware. Students will gain experience in interactive computer graphics using the OpenGL API. Students will gain experience using a graphics application programming interface (OpenGL) by completing several programming projects.

Course Contents:

Unit- I

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scandisplays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawingalgorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallelversionofthese algorithms.

Unit– II

Transformations: Basic transformation, Matrix representations and homogenous coordinates,Compositetransformations,Reflectionsandshearing.

Windowing and Clipping:Viewing pipeline, viewing transformations, 2-D Clipping algorithms-Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barskyalgorithm, Line clipping against non-rectangular clip windows; Polygon clipping – SutherlandHodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Textclipping.

Unit– III

Three Dimensional: 3-D geometric primitives, 3-D Object representation, 3-D Transformation,3-Dviewing,projections,3-D Clipping.

Unit– IV

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, IntroductoryconceptsofSpline, Bspline and Beziercurvesandsurfaces.Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A-buffermethod, Scan line method, basic illumination models– Ambient light, Diffuse reflection,Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation,Color consideration,Transparencyand Shadows.

Course Learning Outcomes (CLOs):

CLO1: Have a basic understanding of the core concepts of computer graphics.

CLO2: Be capable of using OpenGL to create interactive computer graphics.

CLO3: Understand a typical graphics pipeline.

CLO 4: Have made pictures with their computer.

Text books:

1.Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, Sixth Edition, Edward Angel, Dave Shreiner, Pearson Education, 2011. ISBN 0132545233.

Reference books:

1.Hughes, Van Dam, et al. Computer Graphics Principles and Practice 3e, Pearson, 2014

2. OpenGL Programming Guide, Addison-Wesley, 2004.

1. OpenGL Reference Manual, Addison-Wesley, 2004.

2. E. Angel, OpenGL: A Primer Addison-Wesley, 2004. P Shirley, Fundamentals of Computer Graphics, 2e, AK Peters, 2005

3. Hearn and Baker Computer Graphics with OpenGL, 3e, Prentice Hall, 2004.

4. Foley and Van Dam, Fundamentals of Interactive Computer Graphics

5. Moller and Haines, Real-time Rendering, AK Peters,

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	- 40%

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

Biotechnology

FOR B. TECH-BIOTECHNOLOGY COURSE

(Effective from Academic session 2018-2019)

Introduction- B. Tech in Biotechnology is an academic programme of the duration of four years. Biotechnology engineering is an undergraduate degree programme in applied sciences that amalgamates the facts from both Biological sciences and technology. This study utilizes the biological processes which include the study of microorganisms or knowledge of antibiotics and further implement them in various industrial purpose.

In simple terms, Biotechnology is a study which involves the use of living organisms. The living organisms are used to make useful chemicals which can be utilized in industries. Biotechnological products are used in areas like agriculture, food sciences and medicine.

Program Educational Objectives (PEOs)

The Department of Biotechnology has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of both Biological sciences and technology, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Programme specific outcome (PSO)

- Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences.
- Acquire knowledge in domain of biotechnology enabling their applications in industry and research.
- Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology
- Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists.
- Understand the applications of biotechnology in all spheres of agriculture and develop crops with improved productivity thereby increasing farmers' income, better human health and decreased environmental pollution.

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B. Tech:

- Every semester shall offer a minimum of 12 credits and a maximum of 24 credits.
- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. Tech Degree Course could vary from a minimum of 158 credits to a maximum of 178 credits.
- All courses of study put together would engage the students for a minimum of 26 periods or hours of study a week and a maximum of 30 periods or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B. Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally, a course which can be chosen from a pool of courses and are of two types:
(i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
(ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate 's proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits
1	Humanities and Social Sciences including Management courses	11
2	Basic Science courses	23
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	20
4	Professional core courses	59
5	Professional Elective courses relevant to chosen specialization/branch	16
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	17
8	Mandatory Courses	0
		*158

***Minor variation is allowed as per need of the respective disciplines**.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (160 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	14	6.5	20.5
2nd	13	4.5	17.5
3rd	18	4	22
4th	18	3	21
5th	18	3	21
6th	15	5	20
7th	14	7	21

8^{th}	6	9	15
Total	**116**	**42**	**158**

Course coding system

Every course coded as follows:

BSC : Basic Science Courses

ESC : Engineering Science Course

MC : Mandatory Courses

HSMC : Humanities and Social Sciences including Management

PCC : Program core courses

PEC : Program Elective courses

OEC : Open Elective courses

SEMESTER I											
S.No	**Course Code**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	BSC 101	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC104	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC 101	English	2	0	0	20	20	40	60	100	2
4	ESC101	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5	ESC103	Engineering Graphics	1	0	0	20	20	40	60	100	1
		Induction Program	-	-	-	-	-	-	-		0
PRACTICALS											
1	BSC 104P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC101P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	ESC103P	Engineering graphics Lab	0	0	4			40	60	100	2
4	HSMC101P	English Lab	0	0	2			40	60	100	1
Total											**20.5**

SEMESTER II												
Sl. No	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**						
			L	**T**	**P**	**CA**	**TA**	**Total**	**External**	**Total**	**Credits**
1	BSC102	Physics	3	1	0	20	20	40	60	100	4
2	BSC 103	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC102	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC104	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	Environmental Studies	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC104P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1
Total											**17.5**

SEMESTER- III											
Sl. No	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	ESC 201	Data Structure & Algorithms	3	1	0	20	20	40	60	100	4
2	HSMC 201/ HSMC 202	Effective Technical Communication/Universal Human values	2 3	1 0	0 0	20	20	40	60	100	3
3	PCC-BT 301	Techniques in Biotechnology	3	1	0	20	20	40	60	100	4
4	PCC-BT-302	Microbiology & Immunology	3	1	0	20	20	40	60	100	4
5	PCC-BT-303	Biochemistry	3	0	0	20	20	40	60	100	3
6	PLC-BT-321	Techniques in Biotechnology Lab	0	0	2	20	20	40	60	100	1
7	PLC-BT-322	Microbiology & Immunology Lab	0	0	2	20	20	40	60	100	1
8	PLC-BT-323	Biochemistry Lab	0	0	2	20	20	40	60	100	1
9	PROJ- BT-01	Mini Project or Internship Assessment*	0	0	2	20	20	40	60	100	1
10		**MOOCs (Essential for Hons Degree)**									
		Total	**19**		**8**					**1000**	**22**

***The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.**

SEMESTER- IV											
Sl. No.	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	BSC 202	Maths V	3	1	0	20	20	40	60	100	4
2	HSMC 202/	Universal Human Values/	3	0	0	20	20	40	60	100	3
	HSMC 201	Effective Technical Communication	2	1	0						
3	PCC-BT 401	Bioprocess Engineering I	3	0	0	20	20	40	60	100	3
4	PCC-BT 402	Genetics & Molecular Biology	3	1	0	20	20	40	60	100	4
5	PCC-BT 403	Enzyme Engineering	3	1	0	20	20	40	60	100	4
6	PLC-BT 401	Bioprocess Engineering I Lab	0	0	2	20	20	40	60	100	1
7	PLC-BT 402	Genetics & Molecular Biology Lab	0	0	2	20	20	40	60	100	1
8	PLC-BT 403	Enzyme Engineering Lab	0	0	2	20	20	40	60	100	1
9	MC 401	Python	2	0	0	20	20	40	60	100	0
10		**MOOCs (Essential for Hons Degree)**									
		Total								**900**	**21**

SEMESTER- V											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	PCCBT 501	Genetic Engineering	3	1	0	20	20	40	60	100	4
2	PCCBT 502	Fermentation Biotechnology	3	1	0	20	20	40	60	100	4
3	PCCBT 503	Bioinformatics I	3	1	0	20	20	40	60	100	4
4	DEBT 1X	Departmental Elective-I	3	0	0	20	20	40	60	100	3
5	DEBT 2X	Departmental Elective-II	3	0	0	20	20	40	60	100	3
6	PLCBT 551	Genetic Engineering lab	0	0	2	20	20	40	60	100	1
7	PLCBT 552	Fermentation Technology Lab	0	0	2	20	20	40	60	100	1
8	PLCBT 553	Bioinformatics- I virtual lab	0	0	2	20	20	40	60	100	1
9	MC 501	Constitution of India	0	0	0	20	20	40	60	100	0
10	PROJ- BT-02	Mini Project or Internship Assessment*	0	0	2	20	20	40	60	100	2
11		**MOOCs (Essential for Hons. Degree)**									
		Total	**15**	**3**	**8**					**1000**	**23**

***The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.**

SEMESTER-VI												
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**						
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**	
1	PCC BT-601	Bioprocess Engineering -II	3	1	0	20	20	40	60	100	3	
2	PCC BT-602	Plant Biotechnology	3	1	0	20	20	40	60	100	3	
3	PCC BT-603	Bioinformatics -II	3	1	0	20	20	40	60	100	3	
4	DE BT 3X	Departmental Elective-III	3	0	0	20	20	40	60	100	3	
5	OE BT X	Open Elective-I	3	0	0	20	20	40	60	100	3	
6	PLC BT-651	Bioprocess Engineering – II Lab	0	0	2	20	20	40	60	100	1	
7	PLC BT-652	Plant Biotechnology Lab	0	0	2	20	20	40	60	100	1	
8	PLC BT-653	Bioinformatics-II Lab	0	0	2	20	20	40	60	100	1	
10		**MOOCs (Essential for Hons. Degree)**										
		Total								**800**	**18**	

SEMESTER-VII												
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**						
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**	
1	HSMC 401	Intellectual Property Rights (IPR) & Regulatory	1	1	0	20	20	40	60	100	2	
2	PCC BT-701	Professional Core Course	2	0	0	20	20	40	60	100	3	
3	DE BT 4X	Departmental Elective IV	3	0	0	20	20	40	60	100	3	
3	DE BT 4X	Departmental Elective V	3	0	0	20	20	40	60	100	3	
4	OE BT X	Open Elective II	3	0	0	20	20	40	60	100	3	
5	PLC BT-751	Professional Core Course Lab	0	0	2	20	20	40	60	100	1	
6	DLE BT-752	Departmental Elective IV Lab	0	0	2	20	20	40	60	100	1	
7	PS 401	Project I	0	0	10	-	-	200	100	300	5	
8		**MOOCs (Essential for Hons. Degree)**										
		Total								**1000**	**21**	

SEMESTER-VIII												
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**						
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**	
1	OE BT X	Open Elective III	2	1	0	20	20	40	60	100	3	
2	OE BT X	Open Elective IV	3	0	0	20	20	40	60	100	3	
3	PS 402	Project II	0	0	18	-	-	300	300	600	9	
4		**MOOCs (Essential for Hons. Degree)**										
		Total								**800**	**15**	

B. TECH BIOTECHNOLOGY
(LIST OF PROFESSIONAL ELECTIVES & OPEN ELECTIVES SUBJECTS)

DEPARTMENTAL ELECTIVES -I
DE BT 11: Pharmaceutical Biotechnology
DE BT 12: Nano Biotechnology
DE BT 13: Biomedical Instrumentation
DE BT 14: Metabolic Engineering

DEPARTMENTAL ELECTIVES - II
DE BT 21: Biofuels and alcohol technology
DE BT 22: Descriptive Statistics & Process Control
DE BT 23: 3-D Printing
DE BT 24: Molecular modelling and drug design

DEPARTMENTAL ELECTIVES – III
DE BT 31: Animal Biotechnology
DE BT 32: Biomarker & Diagnostics
DE BT 33: Food Biotechnology
DE BT 34: Entrepreneurship in Biotechnology

DEPARTMENTAL ELECTIVES – IV
DE BT 41: Big Data Analytics
DE BT 42: Biosimilar Technology
DE BT 43: Stem Cell Technology
DE BT 44: Gene Expression & Transgenic

DEPARTMENTAL ELECTIVES – V
DE BT 51: Precision Medicine & Wellness
DE BT 52: Tissue Engineering
DE BT 53: Waste Management & Upcycling

OPEN ELECTIVES-I
1. Database Management System
2. Embedded System
3. GIS & Remote Sensing
4. Computer based Numerical Techniques

OPEN ELECTIVES-II
1. Internet of Things
2. Artificial Intelligence
3. Software Project Management System

OPEN ELECTIVES-III
1. Robotics
2. Food and Nutrition Technology
3. Cyber Security

OPEN ELECTIVES-IV
1. Bioterrorism and National Security
2. Data Sciences
3. Block chain

SEMESTER-I

DETAILED CURRICULUM CONTENTS

Course Code: BSC101 **Course Name:** Mathematics-I
Course Credit: 4 **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

UNIT-I: Calculus: (6 lectures)
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

UNIT-II: Calculus: (6 lectures)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

UNIT-III: Sequences and series: (10 lectures)
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT-IV: Multivariable Calculus (Differentiation): (8 lectures)
Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

UNIT-V: Matrices (10 lectures)
Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems
- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:

https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: BSC102 **Course Name:** Chemistry-I
Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces, Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

UNIT-I: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT-II: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

UNIT-III: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

UNIT-IV: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT-V: Periodic properties
Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT-VI: Stereochemistry
Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

UNIT-VII: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):
The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomer, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.
    - Draw the E or Z isomer of a given alkene [illegible]
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

- B. H. Mahan, "University chemistry", Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", McGraw- -ill International.
- C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry" (NPTEL).
- K. P. C. Volhardt and N. E. Schore, " Organic Chemistry: Structure and Function" Freeman.

Online links for study & reference materials:
https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC101 **Course Name:** English
Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

UNIT-I: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

UNIT-II: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating Coherence Organizing principles of paragraphs in documents Techniques for writing precisely

UNIT-III: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

UNIT-IV: Nature and Style of sensible Writing (4 lectures)
Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

UNIT-V: Oral Communication **(4 lectures)**
(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.

- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ECS101 **Course Name:** Programming for Problem Solving
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

UNIT-I: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.), Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT-II: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT-III: Arrays
Arrays (1-D, 2-D), Character arrays and Strings.

UNIT-IV: Basic Algorithms
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

UNIT-V: Function
Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

UNIT-VI: Recursion
Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-VII: Structure
Structures, Defining structures and Array of Structures.

UNIT-VIII: Pointers
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-IX: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.

- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

(i) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
(ii) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
(iii) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:
https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS
FIRST SEMESTER

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving
Course Credit: 2 **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary. If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

   R=1 c=1 sum=2
   R=1 c=2 sum=3
   R=2 c=1 sum =3
   R=2 c=2 sum=4

6. Write a program to print the following pattern

```
*****       *          1
*****       **         12
*****       ***        123
*****       ****       1234
            *****      12345
```

7. Write a program to print the square and cube of any given number.

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
    - Find the length of the string.
    - Concatenate two strings
    - Compare two given strings
    - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty-five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.

4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers**.**
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab

Course Credit: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr'sMethod.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodiumhydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

SEMESTER-II

DETAILED CURRICULUM CONTENTS

Course Code: BSC102 **Course Name:** Physics

Course Credit Hour: 4 **Total Contact Hour:** 42hr

Course Objective:

At the completion of this course, a student will be able to:

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description:

This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

UNIT-I: Wave nature of particles and the Schrodinger equation (8 Lectures)

Introduction to Quantum mechanics
Wave nature of particles
Time independent and time dependent Schrodinger equation for wave function
Born interpretation
Probability current
Expectation values
Free particle wavefunction and wave packets
Uncertainty principle

UNIT-II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

UNIT-III: Applying the Schrodinger equation (15 Lectures)

Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator

Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

UNIT-IV: Introduction to Molecular Bonding (4 Lectures)

Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical Bonding Hybridization

UNIT- V: Introduction to Solids (7 Lectures)

Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars
Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands
Numerical solution for energy in one dimensional periodic lattice by mixing plane waves.

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BSC103 **Course Name:** Mathematics II

Course Credit Hour: 4 **Total Contact Hour:** 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

UNIT I: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT II: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for *x* and Clairaut's type.

UNIT III: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

UNIT IV: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

UNIT V: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.

- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: **ESC102** **Course Name:** Workshop/Manufacturing Practices

Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

UNIT I:

Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

UNIT II:

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel.

Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

UNIT III:

Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

UNIT IV:

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.

Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.

Gas & Spot Welding To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

UNIT V:

Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ESC104 **Course Name:** Basic Electrical Engineering
Course Credit: 5 **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

UNIT I: DC Circuits
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II: AC Circuits
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III: Transformers
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV: Electrical Machines
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT V: Power Converters
DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

UNIT VI: Electrical Installations (6 hours)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):
At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3: Understand the basic concept of components of low-voltage electrical

Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, " Basic Electrical Engineering", Tata McGraw Hill.
- D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference books:

- L. S. Bobrow, " Fundamentals of Electrical Engineering", Oxford University Press.
- E. Hughes, "Electrical and Electronics Technology", Pearson.
- V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: AECCI **Course Name:** Environmental Science

Course Credit Hour: 2 **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

UNIT I: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

UNIT II: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem Physical (energy flow), Biological (food chains, food web, ecological succession) and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

UNIT III: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

UNIT IV: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots

- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

UNIT V: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

UNIT VI: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

UNIT VII: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom
- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):
The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones.
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 ¬
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 ¬
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 ¬
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:
https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS
SECOND SEMESTER

Lab Code: BSC101P **Lab Name:** Physics Lab

Course Credit Hour: 1.5hr **Total Contact Hour:** 03

List of Experiments:

1. Four Probe Setup
2. Stefan`s Law
3. Diode Valve Characteristics
4. Frequency of A.C Mains
5. Band Gap in a Semi-Conductor Diode
6. P-N Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor Common-Base Configuration
9. Transistor Common-Emitter Configuration

Lab Code: ESC102P
Course Credit Hour: 2hr

Lab Name: Workshop/Manufacturing Practice
Total Contact Hour: 04

List of Experiments:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical &Electronics
5. Carpentry
6. Plastic molding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

Lab Code: ESC104P **Lab Name:** Electrical Engineering Lab
Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

1. Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. To verify KCL and KVL in D.C.circuit
3. To verify Superposition theorem
4. To Verify The venin's Theorem
5. To find resonance in series R-L-C circuit.
6. Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
8. Torque Speed Characteristic of separately excited dc motor.
9. Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
10. Demonstration of Components of LT switchgear.

SEMESTER III

Course Code: ECS 201

Course Name: Data Structure & Algorithms

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.

Course Description:

This course will describe common applications for arrays, records, linked structures, stacks, queues, trees and graphs.

Course Contents:

UNIT-I:
Introduction to data structure and Algorithms: Performance analysis of Algorithm, time complexity, Big-oh notation, Elementary data organization data structure operations, Recurrences, Arrays, Operation on arrays, representation of arrays in memory, single dimensional and multidimensional arrays, spare matrices, Character storing in C, String operations.

UNIT-II:
Stacks, Quesues and Linked Lists: Stack operation, PUSH and POP, Array representation of stacks, Operation associated with stacks Application of stacks, Recursion, Polish experession, Representation quesuesopration on quesues, Priority quesuesDquesues, Singly and circularly linked list, List operations Lists implementations.

UNIT-III:
Tree: Basic terminology, Binary Trees, Binary tree representation, Algebraic/expressions, Complete Binary Trees, Extended binary tree, representing binary tress in memory, linked representation of Binary trees, Traversing binary trees & Searching in binary trees, Inserting in binary search trees, Complexity of searching algorithm, Heaps, general trees, Threaded binary tree.

UNIT-IV:
GraphS: Terminology & representations, Graphs &Multigraphs, Directed Graphs, Sequential representation of graphs, adjacency Matrices, Transversal, connected component and spanning trees, Minimum Cost spanning tree, Prims and Kruskal Algorithm, BFS, DFS, Shortest path and transitive closure, Activity networks, topological sort and critical paths.

UNIT-V:
Searching and Sorting: Linear search, binary Search, Internal and External sorting, Bubble sorting, selection sort, Insertion sort, quick sort, Two way merge sort, Heap sort, sorting on different keys, practical consideration for internal sorting, External Sorting, Storage Devices: Magnetic tapes, Disk Storage, Sorting with disks and Indexing techniques, introduction to B tree and B+ tree, File organization and storage management, Introduction to hoisting.

Course Learning Outcomes (CLOs):

CO1: Designs and analyzes simple algorithms

CO2: Understands and restates the fundamentals of basic data structures.

CO3: Develops skills in implementations and applications of data structures.

Text books:

1. Data Structures and Algorithms, A.V. Aho, J.E. Hopcroft and J. Ullman, Addison- Wesley Publishing
2. Database Design, Development and Deployment with Student CD, P. Rob and E. Semaan, McGraw-Hill/Irwin
3. Schaum‟s Outline of Data Structures with C++, J.R. Hubbard, McGraw Hill Trade.

Reference books:

1. Database system concepts, A. Silberschatz, P.B. Galvin and G. Gagne, John Wiley and Sons Inc.
2. Introduction to Data Structures and Application, J. Tremblay and P.G. Sorensen, McGraw Hill College Division

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC 201

Course Name: Effective Technical Communication

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The course aims to provide insights related to communication skills. It aims to train the student to the basic concept of effective communication and self-development preparation.

Course Description:

This course introduces the fundamental concepts of communication skills, writing skills presentation skills and technical skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills. Goal settings

Course Contents:

UNIT-I: Information Design and Development-
Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

UNIT-II: Technical Writing, Grammar and Editing-
Technical writing process, forms of discourse, writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Human factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

UNIT-III: Self Development and Assessment-
Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, taking notes; Complex problem solving; Creativity

UNIT-IV: Communication and Technical Writing-
Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

UNIT-V: Ethics-
Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, engineering ethics, managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, taking notes, Complex problem solving, Creativity.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basics about organization and documents.
CLO-2: Inculcate writing skills and grammar.

CLO-3: Develop the importance of self-analysis and self-awareness.
CLO-4: Understand technical writing skills, Public speaking
CLO-5: Demonstrate ethical skills.

Text books:

(i) Raman, Singh – Business communication – Oxford Press
(ii) The sounds of English, Veena Kumar, Makaav Educational Software, New Delhi.
(iii) David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. NewYork, 2004
(iv) Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN0312406843)

Reference books:

(i) English Phonetics & Phonology, P. Roach, Cambridge University Press, London
(ii) Shiv Khera, You Can Win, Macmillan Books, New York, 2003.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 301 **Course Name**: Techniques in Biotechnology

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

To learn different modern analytical techniques used in biotechnology and to give students a solid foundation in biology and chemistry.

Course Description:

To develop analytical and critical thinking skills in biological phenomena through scientific methods. Student will be prepared for understanding further courses related to biochemical engineering and improvement in analytical skills.

Course Contents:

UNIT-I: Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, Electron microscopy: TEM and SEM, Atomic force microscopy and con focal scanning laser microscopy. Differential interference contrast microscopy

UNIT-II: Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography.

UNIT-III: Electromagnetic radiation and spectrum,Atomic absorption and Atomic emission spectroscopy,Principle, working and applications of UV-VIS, NMR, ESR and IR spectrometer, Principle and applications of Mass Spectroscopy, Circular Dichorism (CD) principles, Principle and applications of Positron Emission Tomography(PET), Basics of X-Ray diffraction analysis and their application in biotechnology .

UNIT-IV: Theory of Electrophoresis, Factors affecting the migration of substances Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting. Theory of centrifugation and sedimentation. Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation. Application of centrifugation for preparative and analytical purpose.

UNIT-V: Principles of 3-D printing, 3-D Bioprinting of tissues, organs and bacteria.Ideal material properties for bioprinting, Biosensors: Principles and definition, characteristics of Ideal biosensors, Biochemical components of biosensors:Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors. Principle and working of Flow Cytometry and cell sorter.

Course Learning Outcomes (CLOs):

CO1: On completion of the **courses** students will be able to understand the basic unit of the organism.

CO2: To differentiate the organisms by its cell structure.

CO3: To know Components of the Cell and their division.

CO4: To explain the arrangement of Genes and their interaction

Text books:

(i) Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.

(ii) Sabari Ghosal & Anupama Sharma Awasthi., Fundamentals of Bioanalytical Techniques and Instrumentation, PHI learning Second edition (2018)

Reference books:

(i) Bioanalytical Techniques by A. Shourie and S S Chapadgaonkar. TERI Press. 2015

(ii) Immunoassay and Other Bioanalytical Techniques. Jeanette M. van Emon. CRC press. 2006

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 302

Course Name: Microbiology and Immunology

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The course provides the students with a conceptual and experimental background in the broad discipline of microbiology. The students will be introduced to the major groups of microorganisms and their diversity in structure and functions and microbial interactions

Course Description:

Emphasis has been laid on bacterial growth, nutrition, control, metabolism, and genetics. The course also introduces the students to the scope and relevance of microbes in the field of medicine, agriculture, and industry.

Course Contents:

UNIT-I:
Morphology and Ultra structure of bacterial cell, Classification of bacteria, Culture media, Isolation of microbes and its identification, culture techniques, Preservation of cultures, Methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics.

UNIT-II:
Basic features of transduction, conjugation and transformation, Viruses: Classification and structure of viruses, Viral reproduction: lytic and lysogenic cycle, Overview of biological nitrogen fixation, Bacterial photosynthesis and electron transport system.

UNIT-III:
Introduction to immune system: Innate and Adaptive immunity, Humoral and Cell mediated immune response, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation and its activation, Characteristics and types of Antigens, Haptens, adjuvants and Epitopes, Antibodies: Structure, functions and characteristics of different classes of antibodies. Monoclonal antibodies.

UNIT-IV:
Antigen and antibody interactions, precipitation reactions , Serological techniques: ELISA, RIA and western blotting, Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Overview of Complement system and cytokines, immune tolerance.

UNIT-V:
Applications of microbiology and Immunology: Mirobiology of domestic water and waste water. Microbes in bioremediation, Microbes of industrial use, Immunity against: Bacterial disease- tuberculosis, typhoid, Protozoan disease- Malaria, Amebieosis and Viral diseases - AIDS, Dengue, Chikungunya,Vaccine’s, Hypersensitivity and Immunotherapy

Course Learning Outcomes (CLOs):

CO1. Student will understand the diversified branches of microbiology
CO2. Student will know the theoretical and practical aspects of microbial growth and physiology
CO3. Students will understand the basic concept of innate and acquired immunity.
CO4. Students will gain knowledge about immunoglobulin structures and diversity of antibodies, morphology and functions of various immune cells such as dendritic cells, macrophages, neutrophils and their association with MHC molecules will be studied.

Text books:

(i) Microbiology by Pelczar (W C Brown publication)
(ii) Genral Microbiology by stainer (Mac Millan Publication)

Reference books:

(i) Microbiology by Pawar and Dagniwala (Himalaya publishing House).
(ii) Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
(iii) Immunology by C. Fatima 3. Immunology by Kuby (Free man publication)

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 303 **Course Name**: Biochemistry

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of general Biochemistry

Course Description:

Students would be able to understand the biochemical basis of cellular functions and organism physiology. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Contents:

UNIT-I:
Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

UNIT-II:
Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

UNIT-III:
Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids. β, α, ω oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

UNIT-IV:
Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

UNIT-V:
Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis: de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism.

Course Learning Outcomes (CLOs):

CO1. Basic knowledge of structure and functions of major bio-molecules will make the students to understand and implement the acquired knowledge in future.
CO2. Understanding of metabolic pathways (catabolism as well as anabolism), their diversity and how these are specifically regulated and interrelated in different cells
CO3. Practical knowledge and hands on tools and techniques for the characterization of bio-molecules will help the students in advanced research programs
CO4. Concepts of enzyme kinetics, regulation and specificity

Text books:

(i) Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
(ii) Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
(iii) Biochemistry: S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference books:

(i) Biochemistry: Stryer, W. H. Freeman
(ii) Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
(iii) Biochemistry: Zubey, WCB.
(iv) Biochemistry: Garrett and Grisham, Harcourt.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

TECHNIQUES IN BIOTECHNOLOGY LAB **P 2**

Subject Code: PLC-BT 321

1. Demonstration of basic concept of precision and accuracy using appropriate experimental data
2. Study of Beer-Lambert's law-using UV-Visible spectrophotometer.
3. To study principle and working of laboratory microscope.
4. To analyze the isolated plant pigments using paper chromatography.
5. Separation of amino acids using thin layer chromatography.
6. Separation of a mixture of polar and non polar compounds using column chromatographic technique.
7. To study and analysis of DNA sample by agarose gel electrophoresis.
8. To study and analysis of protein sample by SDS- PAGE
9. To study the separation of compounds using liquid-liquid extraction experiments.
10. To study the separation of biological compounds using various membrane separation.

Reference book:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

MICROBIOLOGY& IMMUNOLOGY LAB P 2

Subject Code: PLC-BT 322

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks)
2. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)
3. Culture of microorganisms using various techniques. (Shakers i.e. Cooling and Open shaker).
4. Simple and differential staining procedures, endospore staining, flageller staining, cell wallstaining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
6. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
7. To determine the blood group and Rh of given blood sample.
8. To perform single radial immunodiffusion anddouble immunodiffusion
9. To perform rocket immune electrophoresis
10. To perform counter current immune electrophoresis
11. To perform ELISA

Practical Books and References:

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

BIOCHEMISTRY LAB P 2

Subject Code: PLC-BT 323

1. Preparation of solutions: 1) Percentage solutions, 2) Molar solutions, 3) Normal solutions
2. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
3. Titration of weak acid-weak base
4. Quantitative estimation of carbohydrates
5. Distinguish reducing and non-reducing sugars
6. Quantitative estimation of proteins
7. Estimation of nucleic acids
8. Isoelectric precipitation
9. Separation of sugars, fatty acids and amino acids by paper chromatography
10. Extraction of lipids from plant material
11. Thin layer chromatography
12. Gel electrophoresis

Reference books:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry", 4 Edn., Cambridge Knew pros 1997.

2. Plummer DT, "An Introduction to Practical Biochemistry", III Edn., Tata McGraw hill.

SEMESTER IV

Course Code: ECS 202 **Course Name:** Mathematics-V
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The main objective of this course is to provide students with the probabilistic and statistical analysis mostly used in varied applications in engineering and sciences and it provide the methods of organizing and simplifying data so that their significance is comprehensible.

Course Description:

This course provides an introduction to probability and statistics with applications. Topics include: random variables, continuous and bivariate probability distributions, Bayesian inference, hypothesis testing, confidence intervals, curve fitting and regression.

Course Contents:

UNIT-I: Basic Probability (12 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

UNIT-II: Continuous Probability Distributions (4 hours)
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

UNIT-III: Bivariate Distributions (4 hours)
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-IV: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-V: Applied Statistics (8 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT-VI: Small samples (4 hours)
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Course Learning Outcomes (CLOs):

CLO-1: Recognize basic probability theory and its application.
CLO-2: calculate Continuous Probability Distributions and their properties.

CLO-3: Calculate bivariate distributions and their properties with applications.
CLO-4: Basic concept of Statistics, Probability distribution and correlation.
CLO-5: Fitting the data and large sample testing.
CLO-6: Testing the hypothesis for Small samples

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
(iii) S. Ross, "A First Course in Probability", Pearson Education India,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) W. Feller, "An Introduction to Probability Theory and its Applications", Wiley,

Online links for study & reference materials:
https://nptel.ac.in/courses/111/105/111105041/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: HSMC 201 **Course Name:** Human Values

Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

- Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Description:

This course introduces the fundamental of human values. It includes important insights about self-exploration, right conduct, ethics and harmony.

Course Contents:

UNIT-I: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4.Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5.Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II: Understanding Harmony in the Human Being - Harmony in Myself!

1.Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2.Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3.Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4.Understanding the characteristics and activities of 'I' and harmony in 'I'.
5.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

UNIT-III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1.Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2.Understanding the meaning of Trust; Difference between intention and competence 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5.

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. 4.Holistic perception of harmony at all levels of existence.

UNIT-V: Implications of the above Holistic Understanding of Harmony on Professional Ethics
1.Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human values
CLO-2: To understand the importance of self-exploration process
CLO-3: To understand harmony at individual levels
CLO-4: To understand harmony at nature level
CLO-5: Develop professional ethics

Textbooks:

(i) Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 Reference Books 1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
(ii) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Reference books:
Human Values and Professional Ethics: Values and Ethics of Profession, Jay Shree Suresh and B.S Bahgvan, S.Chand

Course Code: PCC BT 401 **Course Name:** Bioprocess Engineering I

Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

Course Objective is to provide basic concepts of bioprocess engineering to the students. They will learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry.

Course Description:

The students will learn the basics of bioreactor design and operation control that have been applied to a variety of bioprocess industries and also conduct related experiments for better understanding

Course Contents:

UNIT-I:

Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law. Measurement of Pressure: Definition of Gauge and & Absolute Pressure, Barometer, Various Manometers (Peizometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications.

UNIT-II:

Flow Measuring Equipment: Head Flow Meters, Nozzel Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments. Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method. Reciprocating pump & its applications. Centrifugal Pumps and its applications.

UNIT-III:

Conduction and Convection Introduction. Basic concepts of conduction in solids, liquids and gases, One and two dimensional heat conduction. Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection, Equations of forced and free convection, Heat flow due to conduction & convection. Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, solar radiations, combined heat transfer coefficients by convection and radiation. Heat Transfer Equipments: Double pipe, Shell & tube and Plate type heat exchanger, Evaporator, Condenser

UNIT-IV:

Diffusion: Fick's Law, steady state diffusion: Rectangular, cylindrical, spherical (1-D); diffusion with reaction, both at surfaces, and in the bulk medium.Transient conduction and diffusion: Basics of Fourier analysis, unsteady state conduction and diffusion (1-D), transient conduction/diffusion with generation/reaction.

UNIT-V:

Mass transfer coefficients, Mass transfer in fluidized bed reactor, flow past solids and boundary layers, Simultaneous heat and mass transfer system. Mass transport in Biomedical and Biological Engineering: Haemodialysis, Diffusion and uptake of ligands by cells, oxygen transport in tissue and capillaries.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%Assignment-3/Quiz-1
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Learning Outcomes (CLOs):

C01: At the end of this course, the students will learn the basics of bioprocess engineering.

CO2: Will also learn the principle, design, and operation control of various types of bioreactors and their scale-up strategies.

CO3: Develop skills to understand Bioprrocess Engineering at Industrial level for its applications.

Text books:

(i) Holman, J.P.: “Heat Transfer” 9 th ed. McGraw Hill (1989).
(ii) Treybal, R “Mass Transfer Operations”, 3rd ed. New York: McGraw-Hill, (1980).
(iii) Introduction of Fluid Mechanics by Robert W.Fox and Slan T. McDonald, John willey & sons, Ny. Fourth Ed.
(iv) Unit Operation in Chemical Engg., McCabe Smith Vth Ed.
(v) Foust A. S. et.al., “Principles of Unit Operations” John Wiley (1980)

Reference books:

(i) Holman, J.P.: “Heat Transfer” 9 th ed. McGraw Hill (1989).

Course Code: PCC BT 402 **Course Name**: Genetics and Molecular Biology

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

To provide students the knowledge about gene organization, genetic materials, molecular heritance, gene transfer, and their regulations. To provide students the knowledge about cellular content, organization, structures, and functions.

Course Description:

This **course** serves as a broad introduction to the structure and function of nucleic acids, basic processes that regulate expression of **genetic information**, **biological** processes that direct inheritance of **genetic information**, and the outcome of those processes – inherited traits

Course Contents:

UNIT-I:

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

UNIT-II:

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

UNIT-III:

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication, DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

UNIT-IV:

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes.

UNIT-V:

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

Course Learning Outcomes (CLOs):

CO1. Students will know about the cell and its biology, which will help the students to understand the origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function – how they obtain energy, synthesize new molecules, communicate, proliferate and survive.
CO2. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
CO3. Students will learn DNA replication, recombination and repair, transcription and translation
CO4. Students will be aware of the modern tools and techniques of genomics and isolation and identification of genes

Text books:

(i) Genetics a conceptual approach, 2nd Edition Benjamin A. Pierc WH freeman and, company, New York.
(ii) Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

(i) Albert B, Bray Denis et al.: Molecular Biology of the Cell, latest ed.
(ii) Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
(iii) Genetics- Strickberger, 2nd.
(iv) Baltimore- Molecular Biology of the Cell.
(v) Advance Genetics by G.S. Miglani, Narosa Publishing House.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 30 **Course Name**: Enzyme Engineering

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course provides the theory and knowledge relevant to the enzymology principles including fundamental properties of enzymes, enzyme catalytic mechanisms and enzyme kinetics. Finally this course serves to provide an awareness of the current and possible future applications of enzyme technologies.

Course Description:

This **course** covers basics and applications concerning enzymes. The knowledge of inorganic chemistry, physical chemistry, organic chemistry and biochemistry will be applied to the understand enzymes. ... It is to cultivate the human resources who can lead advanced science and **engineering** through the studies of enzymes.

Course Contents:

UNIT-I:

Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Numerical related to enzyme kinetics, Multi-Substrate reac0tion mechanisms.

UNIT-II:

Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

UNIT-III:

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

UNIT-IV:

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

UNIT-V:

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Course Learning Outcomes (CLOs):

CO1. Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms
CO2. Apply biochemical calculation for enzyme kinetics
CO3. Compare methods for production, purification, characterization and immobilization of enzyme.
CO4. Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

Text books:

(i) Fundamentals of enzymology by Nicolas C. price and Lewis stevens. Oxford University Press
(ii) Enzymes by Trevor palmer, East west Press
(iii) Enzyme Technology by Messing

Reference books:

(i) Enzymes: Dixon and Webb. (IRL Press)
(ii) Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
(iii) Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MC-02 **Course Name:** Python
Course Credit Hour: 3hr **Total Contact Hour:** 34hr

Course Objective:

- Master the fundamentals of writing Python programs
- Learn basic Python coding elements such as variables, identifiers and flow control structures.
- Discover how to work with lists and sequence data.
- Write Python functions to facilitate code reuse.
- Work with the Python standard library
- Explore Python's object-oriented features

Course Description:

This is an introductory course designed for any student interested in using computation to enhance their problem solving abilities. No prior experience in programming is necessary. Students will use their problem solving abilities to implement programs in Python. This course will develop a basic understanding the Python programming language

Course Contents:

UNIT-I:

Introduction to Python: - History of python programming language, thrust areas of python, overview of programming in Python, identifiers, variables, Expressions and statements, Operators and Operands, data types, indentation, comments, reading input.

UNIT-II:

Control flow Statements:-if statement, if-else statement, if-else-elif control flow statement, nested if statement, the while loops, the for loop, Strings: Creating and storing strings, basic string operations, formatting strings and string operations.

UNIT-III:

Functions: Built in functions, function definition and calling the function, default parameters, Lists: Creating list, basic list operations, build in functions used in list, list methods, Dictionaries: Creating dictionaries, built on functions used in dictionaries, dictionary methods.

UNIT-IV:

Tuples: Creates tuples, basic tuple operations, tuple methods, Sets: set methods, Basics Object –oriented Programming: classes and objects, creating classes and objects in python, classes with multiple objects, class attributes vs. data attributes.

Course Learning Outcomes (CLOs):

At the end of the course students will demonstrate the ability to

- Understand python identifiers, variables, Expressions, statements, Operators, operand and data types.
- Implement Conditionals and Loops for Python Programs.
- Use functions and represent Compound data using Lists, Tuples, Dictionaries and strings.
- Implement basics object –oriented components.

Text books:

(i) Bill Lubanovic, Introducing Python- Modern Computing in Simple Packages, O'Reilly Publication.

(ii) Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.

Reference books:

(i) Guido Van Russom, Fred L. Drake, An Introduction to Python, Network Theory Limited.

(ii) Magnus Lie Hetland, Beginning Python: From Novice To Professional, Pearson Education.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	-05%
Assignment -2	- 05%
Assessment -3(Mid Term-exam)	-20%
Assignment -3	- 05%
Assessment-4/ Quiz	- 05%
Total Internal Assessment	**- 40%**

Bioprocess Engineering Lab-I

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2

1. To find the thermal conductivity of liquid / gases

2. To determine the local velocity pressure with the help of pilot tube

3. To find out the thermal conductivities of Metal rod

4. To study the characteristics of a centrifugal pump.

5. To determine the viscosity of a given viscous liquid by capillary tube flow method.

6. To differentiate between laminar and turbulent flow using Reynolds experiment.

7. To determine velocity through orifice meter, venture meter

8. To determine the overall heat transfer coefficient in Parallel flow heat exchanger/counter flow heat exchanger

9. To determine the drying characteristics of given sample

10. To determine the minimum fluidization velocity in a fluidized bed and verifyexperimentally

1. How to calculate genetics and allelic frequencies numeric problem analysis.

2. Isolation of Plasmid DNA

3. Isolation of Plant DNA

4. Estimation of DNA content in the given sample by spectrophotometer

5. Determination of Tm of DNA.

6. Isolation of bacterial genomic DNA.

7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.

8. Polyacrylamide gel electrophoresis of DNA.

9. PCR amplification of DNA and visualization by gel electrophoresis.

10. Isolation and study of polytene chromosome in Drosophila.

ENZYME ENGINEERING LAB

1. Production of commercially important enzymes from microbial sources.

2. Isolation of alpha amylase from plant source

3. Determination of enzyme activity and specific activity.

4. Partial purification of isolated enzymes.

5. Method of checking the purity of the enzyme -SDS-PAGE

6. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.

7. Identification of Enzyme by different assay

8. Purification of enzymes by different methods

9. Immobilization of enzymes –Different Techniques such as adsorption entrapment, encapsulation and cross-linking.

10. Strain improvement techniques- physical, chemical and genetic manipulation methods.

11. Formulation of enzyme stability.

12. Enzyme inhibition

SEMESTER V

Course Code: PCC BT 501 **Course Name**: Genetic Engineering

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The student would be able to understand the working details of the cloning of a gene. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Description:

It is intended to impart basic undergraduate-level knowledge in the area of molecular biology and recombinant DNA technology. The use of virtual lab and computational tools would enable them to perform *in silico* cloning of the selected DNA.

Course Contents:

UNIT-I:
Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting); Introduction of recombinant DNA in to host cells and selection methods.

UNIT-II:
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antisera.;cloning of insulin gene and other genes of commercial interest, strain improvement of industrially important organisms.

UNIT-III:
Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons, Applications of PCR; Site directed mutagenesis.; molecular markers (RAPD, RFLP, AFLP, SNP)

UNIT-IV:
Applications of genetic engineering; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.

Course Learning Outcomes (CLOs):

CO1. Students will become familiar with the tools and techniques of genetic engineering DNA manipulation enzymes, genome and transcriptome analysis and manipulation tools, gene expression regulation, production and characterization of recombinant proteins.
CO2. This course exposes students to the applications of genetic engineering in biological research.
CO3. Students will be able to perform basic genetic engineering experiments at the end of course.
CO4. Students will acquire knowledge of advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.

Text books:

(i) T.A Brown (2006). Gene cloning and DNA analysis, WILEY- BLACKWELL
(ii) 0Molecular Biology of the Cell by Bruce Alberts.6th edition

Reference books:

(i) Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition (Vol.1,2,3) S.B Primrose (2001). Molecular biotechnology.Panima Publishing
(ii) corporation, 2ndedition
(iii) Genetic Engineering by Dr Smita Rastogi & Dr Neelam Pathak, Oxford University Press

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 502
Course Name: Fermentation Biotechnology
Course Credit Hour: 3Hr
Total Contact Hour: 30hr

Course Objective:

The objective of this course is to study the principle of sterilization necessary for **fermentation**. To study the cell growth and product formation. To evaluate the kinetics and mechanism of microbial growth.

Course Description:

This **course** emphasizes the application of biological and engineering principles to problems involving microbial, mammalian, and biological/biochemical systems. The aim of the **course** is to review fundamentals and provide an up-to-date account of current knowledge in biological and biochemical technology.

Course Contents:

UNIT-I:
Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Microbial culture selection for fermentation processes, Strain development; Preservation and improvement of industrially important microorganisms**.**

UNIT-II:
Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples

UNIT-III:
Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.

UNIT-IV:
Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression;Concept for overproduction ofprimary and secondary metabolites.

UNIT-V:
Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)-Microbial Transformations, Microbial leaching.

Course Learning Outcomes (CLOs):

CO1: To study the design and construction of fermentor and parameters to be monitored and controlled in fermentation process..
CO2: To study the principle of sterilization necessary for fermentation.
CO3: To study the cell growth and product formation.
CO4: To evaluate the kinetics and mechanism of microbial growth..

Text books:

(i) Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.
(ii) Principles of Fermentation Technology-Whitaker & Stanbury

Reference books:

(i) Industrial Fermentations-Leland, N. Y. Chemical Publishers.
(ii) Prescott and Dunn's-Industrial Microbiology, 4 th, ed.
(iii) Biotechnology Series, Rehm, Reed &Weinheim, Verlag-Chemie.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 503 **Course Name**: Bioinformatics I

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course is beneficial for students to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms.

Course Description:

This course is a survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine. This course will build the foundation of sequence alignment techniques and find evolutionary connections. It will help students to analyze mRNA expression data and gene annotations.

Course Contents:

UNIT-I:
Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, FASTA, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles

UNIT-II:
Sequence Alignment and Database Searching: Introduction, Evolutionary Basis of Sequence Alignment, Optimal alignment method, Statistical Significance of Alignment. Database searching Artifacts; Database similarity searching: FASTA, BLAST, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

UNIT-III:
Scoring Matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, Principles based on which these matrices are derived and Gap Penalty; Predictive Method using Nucleotide Sequence: Introduction, marking repetitive DNA, Database search, Codon bias detection, detecting functional site in DNA

UNIT-IV:
Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

UNIT-V:

Protein identification based on composition, Physical properties based on sequence, Motif and pattern, Secondary structure (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and folding classes, specialized structure or features, Tertiary structures (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing.

Course Learning Outcomes (CLOs):

CO1: After completing this course student will perform computational analyses of biological sequences, genome-wide studies
CO2: Relate the results to core principles of biology; use computational methods to help execute a biological research plan
CO3: Analyze biological problems and data using the latest machine learning and deep learning techniques.
CO4: Understand the notion of similarity, identity, and gaps in the context of sequence alignment and deduce evolutionary relationships among sequences; analyze microarray and RNA-seq gene expression data.

Text books:

(i) D.W.Mount; Bioinformatics-Sequence and genome analysis; Cold Spring
(ii) HarbourLab press.
(iii) B.N.Mishra; Bioinformatics: Concept and application, Pearson Education (in press)

Reference books:

(i) O' Reilly; Developing Bioinformatics computer skills-1stIndian edition, SPD publication.

(ii) Anthony J.F. Griffiths et al; An introduction to genetic analysis, 1stEd

(iii) Michael Starkey and Ramnath Elaswarapu; Genomics protocols, Humana press

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 11

Course Name: Pharmaceutical Biotechnology

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The science of Pharmaceutical biotechnology is a dynamic science aims at focusing the attention of students at some basic knowledge about biological techniques used in production some of biological drugs as Penicillin and monoclonal antibodies and some basic principles and definitions related to Pharmaceutical biotechnology as tissue culture and genetic engineering.

Course Description:

The **Pharmaceutical Biotechnology course** is a mixture of molecular biology and **biotechnology**. ... It involves the study of microorganisms, living organisms, pharmaceutics, pharmacogenomics, and other **pharmaceutical** drugs.

Course Contents:

UNIT-I:

Introduction to drugs and pharmacy: An overview and history of pharmaceutical industry. Introduction: Therapeutic categories such as Analgesics, Anticancer, Antiviral, Anticoagulant, Analgesics, Antibiotics, Use of therapeuticagents, Biopharmaceuticals.

UNIT-II:

Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Specialrequirement for bulk drug manufacture.

UNIT-III:

Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses,coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquidsinjections-ointment-topical applications, Preservation, analytical methods and test for variousdrug and pharmaceuticals, packing-packing techniques, quality management.

UNIT-IV:

New drug development and approval process: Strategies for new drug discovery, finding a lead compound, combinatorial approaches to new drug discovery, pre-clinical and clinical trials, GMP, Economics of drug development.

UNIT-V:

The business and the future of Biopharmaceuticals. Drug regulation and control.Scope and applications of biotechnology in pharmacy.

Course Learning Outcomes (CLOs):

CO1: Acquire knowledge in basic principles of genetic engineering and enzyme technology
CO2: Apply the principles of biosensors and protein engineering in Pharmaceutical Industry
CO3: Explain the concepts of rDNA technology and its applications
CO4: Describe the concept of immunity and production of vaccine.

Text books:

(i) Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology, Wiley (1998).

(ii) Leon Lachman et al :Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986

Reference books:

(i) Remington's Pharmaceutical Science, Mark Publishing and Co

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40**

Course Code: DE BT 12

Course Name: Nano Biotechnology

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The objective of this course is to have knowledge of the Nanoscience and related fields. To make the students acquire an understanding the Nanoscience and Applications and also to help them understand in broad outline of Nanoscience and **Nanotechnology**.

Course Description:

Nanotechnology illustrated with original scientific literature; experimental techniques that can be used to study nanoscale materials and phenomena; material properties on the nanoscale

Course Contents:

UNIT-I:
Nanobiotechnology, History, Origin, Fundamental Concepts, Bottom- up versus Top-down approaches, Discussion on Micro and Nanofabrication, Current research, Tool and Techniques, Applications and Implications and Nanofabrication.

UNIT-II:
Carbon nanotubes and related structures, Properties, Synthesis, Applications, Metal nanoparticles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles and Nano chemicals.

UNIT-III:
Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), improved nanodiagnostic devices, Drug delivery tools through nanotechnology

UNIT-IV:
Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas

UNIT-V: V:
Micro and Nano biosensor, Bioavailability, Nanoimaging agents, Tumor Targeting through nanotechnology, Quantam dots technology and its applications

Course Learning Outcomes (CLOs):

CO1. Students will understand the fundamental principles of nanotechnology and their application to biomedical engineering.
CO2. Students will gain knowledge about state-of-the-art nano-fabrication methods
CO3. This course will offer students a comprehensive package of knowledge about the characterization methods for nanomaterials, critiquing nanomaterial safety and handling methods required during characterization

Text books:

(i) Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.

(ii) Guozhong Cao ,"Nanostructures and Nanomaterials , synthesis , properties and applications" , Imperial College Press ,2004.

(iii) Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press,2002

Reference books:

(i) Microfabrication and Nanomanufacturing- Mark James Jackson.

(ii) MEMS and Nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 13

Course Name: Biomedical Instrumentation

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The course has the following objectives:

- To introduce a fundamentals of transducers as applicable to physiology
- To explore the human body parameter measurements setups
- To make the students understand the basic concepts of forensic techniques.

Course Description:

The **course** is designed to give the basic concepts of **Instrumentation** involved in **medical** field and human physiology. **Biomedical Instrumentation** is application of technology for **Medical** field. The **course** will make the students understand the devices used in diagnosing the diseases

Course Contents:

UNIT I:

History and development of biomedical instrumentation, biometrics, Basic transducer principles: active and passive transducers, tranducers for biomedical applications; origin of biopotential and its propagation, sources of bioelectric potentials, electrocardiogram, electro encephalogram, electromayogram and other bioelectric potentials. Biopotential Electrodes: types of electrodessurface, needle and microelectrodes, biochemical tranducers.

UNIT II:

The Cardiovascular system, Cardiovascular measurements: electrocardiography, measurement of blood pressure, measurement of blood flow and cardiac output, plethymography, measurement of heart sounds; Patient care and monitoring: elements of intensive care unit, pacemakers and defibrillators , Measurements in the respiratory system: mechanics of breathing, gas exchange and distribution, respiratory therapy equipment.

UNIT III:

Non-invasive diagnostic instrumentation: Temperature measurements ultrasonic measurements, the nervous system and neuronal communication measurement in nervous systems,Instrumentation for sensory measurements and the study of behaviors, pshycophysiological measurements, Biotelemetry.

UNIT IV:

Instrumentation for the clinical laboratory, Automation of chemical tests, Biomedical instruments for surgery, Haemodialysis machines. X-ray machines and digital radiography.

UNIT V:

Medical Imaging equipments, the computer in biomedical instrumentation and applications, microprocessors, Electrical safety of medical equipment, physiological effects of electric current

Course Learning Outcomes (CLOs):

CO1: Understand the physiology of biomedical system
CO2: Measure biomedical and physiological information.
CO3: Discuss the application of Electronics in diagnostics and therapeutic area

Text books:

(i) Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
(ii) Biomedical Instrumentation: Technology and Applications by Raghbir Singh
(iii) Medical Instrumentation for Health Care by Leslie Cromwell

Reference books:

(i) Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop

(ii) Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 14 **Course Name**: Metabolic Engineering
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

Metabolic engineering is an emerging field of biotechnology/bioprocess engineering which aims towards purposeful modification of cellular (metabolic, gene regulatory, and signalling) processes/networks to achieve desirable goals such as enhanced production of metabolites including pharmaceuticals, biofuels and biochemicals and other biotechnology products.

Course Description:

This course aims to provide fundamental and advanced knowledge in the development of microbial strain for bio production through metabolic engineering.

Course Contents:

UNIT I:
Basic concept of metabolism, anabolism & catabolism, Importance of metabolic engineering General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis.Understanding the role of Bioinformatics in the study of metabolic pathways.

UNIT II:
Synthesis of primary metabolites: Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products

UNIT III:
Biosynthesis of secondary metabolites: Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, producers of secondary metabolites, applications of secondary metabolites.

UNIT IV:
Bioconversions: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances

UNIT V:
Regulation of enzyme production: Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities.

Course Learning Outcomes (CLOs):

CO1: Describe the design-build-test-learn cycle of metabolic engineering.
CO2: Understand the principles of enzyme function, kinetics and regulation.
CO3: Describe metabolic physiology in a quantitative manner.
CO4: Describe metabolic networks computationally as stoichiometric and kinetic models.

Text books:

(i) G. Stephanopoulos, A. Aristidou and J. Nielsen, Metabolic Engineering Principles and Methodologies, Academic Press, 1998

(ii) Daniel I. C. Wang, Malcolm D. Lilly, Arthur E. Humphrey, Peter Dunnill,

(iii) Arnold l.Demain, Fermentation and Enzyme Technology,1st edition John Wiley& Sons, Reprint, 2005

Reference books:

(i) Christina Smolke, The Metabolic Pathway Engineering Handbook (Two Volume) Set 1st edition CRC press, 2009.

(ii) Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press,1984.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 21 **Course Name**: Biofuels & Alcohol Technology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course "focuses on combustion fuels made from nonpetroleum sources and introduces the sources, processing, and social impacts of biofuel utilization." The materials included are intended to provide instructors with content to teach a 3-credit course.

Course Description:

Engaged in academic, research & development and extension activities in the area of alcohol production, distillery effluent treatment, biofuels & byproducts. To undertake research for developing cost-effective alcohol production technologies from alternate raw materials.

Course Contents:

UNIT I:
Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.

UNIT II:
Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modem techniques of Continuous fermentation, Bio still fermentation, Encillium process, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation

UNIT III:
Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol. Alcohol distillation-The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry

UNIT IV:
Various biofuels/ bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.

Course Learning Outcomes (CLOs):

CO1: At the end of the course students will be able to describe how petroleum and bio-based fuels affect the global carbon cycle.
CO2: the attributes of biofuels that make them suitable as a fuel for a specific application
CO3: limitations of biofuels, global impacts of biofuels on food and energy supplies
CO4: technological advances and challenges to be overcome for a wide-scale biofuel adoption."

Text books:

(i) Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kwenneth M. Watson, and Roland A Ragatz, CBS
(ii) Publishers and Distributors (1995).
(iii) He alcohol text book by Kathryn AnnJacques, T. P. Lyons, D. R. Kelsall

(iv) Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990

Reference books:

(i) Shreve's Chemical Process Industries , 5th Ed. Reference
(ii) Outlines of Chemical Technology by Charles E. Dryden

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 22 **Course Name**: Descriptive Statistics & Process Control
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course should have an enhanced knowledge and understanding of mathematical modeling and statistical methods in the analysis of biological systems and be aware of the use of computers to assist them in studying mathematical functions and carrying out statistical tests.

Course Description:

The course provides an overview of the methodology used to evaluate a process using statistical methods, and using this information to evaluate and take action on both the process and the output from the process.

Course Contents:

UNIT I: Descriptive Statistics:
Diagrammatic and graphical representation of numerical data, Formation of frequency distribution, histogram, cumulative frequency distribution, polygon and O-give curve, measures of central tendencies – mean, median, mode. Measures of dispersion: mean deviation, standard deviation, variance, quartile deviation and coefficient variance, Moments (up to 4th), Measures of skewness and kurtosis for grouped and ungrouped data.

UNIT II: Probability & Hypothesis Testing:
Concept of Probability – Classical definition, Basic theorems of probability, Types of probability, Conditional probability, Theorem of total probability, Normal Distribution, The Central Limit Theorem, Binomial distribution, Poisson's Distribution, The Poisson's approximation to the Binomial Distribution. Testing of significance, large sample test for population mean and proportions, Test of population means-single, two samples, and paired t-test, chi square test. ANOVA

UNIT III: Correlation and Regression analysis:
Product moment and rank, correlation coefficient, simple regression, method of least squares for estimation of regression coefficients, concept of sampling and sampling distribution, sampling from nominal distribution, standard error

UNIT IV: Design of Experiments (DOE):
Design of Experiments (DOE) approach to optimization - traditional (linear) approach (OFAT) and multi-dimensional approach (Box-Bhenken Design, central composite design, Plackett-Burman Design, Downhill Method, Full factorial, Fractional factorial design)

UNIT V: Control Charts:
Introduction to statistical process control and capability analysis: Chance and assignable cause of quality variation, Statistical basis of process monitoring: control chart, choice of control charts, analysis of control chart, variable of control charts, X bar and R chart, Attribute control chart, Determining process and measurement capability

Course Learning Outcomes (CLOs):

CO1. Students will understand and apply statistical methods for the design of biomedical research and analysis of biomedical research data
CO2. Students will learn the use of mathematical and statistical theory and application of biostatistical methods; use & interpret results from specialized computer software for the management and statistical analysis of research data
CO3. Students will learn to participate in a research team setting in study design, data coordination and management and statistical analysis and reporting of study results
CO4. Students will participate in a research team for the development and evaluation of new and existing statistical methodology

(i) Snedecor G. W. and Chochran W. G., Statistical Methods, 1989.

(ii) Douglas C Montgomery: Statistical Quality Control 7thedn.

Text books:

Reference books:

(i) Douglas C Montgomery: Applied statistics and Probability for engineers, 4thedn

(ii) TT Soong: Fundamentals of probability and statistics for engineers

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 23 **Course Name**:3D Printing Techniques

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The student will be able to gain knowledge and skills related to 3D printing technologies. environment. To understand the various software tools, process and techniques for digital manufacturing. To apply these techniques into various applications.

Course Description:

To understand the various software tools, **process** and **techniques** for digital manufacturing. To apply these **techniques** into various applications. After completion of this **course**, the students will be able to: •Develop CAD models for **3D printing**. ... Produce a product using **3D Printing** or **Additive Manufacturing** (AM).

UNIT I:
Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields

UNIT II:
Liquid based systems: Stereo lithography apparatus (SLA): Models and specifications, process,working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies.

UNIT III:
Solid based systems: Laminated object manufacturing(LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

UNIT IV:
Powder Based Systems: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Course Content:

Course Learning Outcomes (CLOs):

After completion of this course:
CO1: The students will be able to Develop CAD models for 3D printing.
CO2: Import and Export CAD data and generate. stl file.
CO3: Select a specific material for the given application.
CO4: Select a 3D printing process for an application.

Text books:

(i) Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles and App0lications, World Scientific publications, 3rdEd., 2010

(ii) D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001

(iii) Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000

Reference books:

(i) Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996

(ii) Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 501 **Course Name**: Molecular Modeling & Drug Design

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective: The objective of this course i.e., Molecular Modeling deals with the ways to mimic the behaviours of molecules and molecular systems. It is invariably associated with computer modeling and has been revolutionized by computational techniques to the extent that most of the calculations could not be performed without the use of a computer, and thus computers have extended the range of models that can be considered and the systems to which they can be applied

Course Description:

The course covers advanced methods and strategies used in medicinal chemistry research with a focus on computer-aided drug design. The course includes protein-ligand interactions, docking, chemo-informatics, molecular dynamics simulations, free energy calculations, and chemigraphy.

Course Contents:

UNIT I:

Introduction to Molecular Modeling; What are models used for? Areas of application – Single molecule calculation, Assemblies of molecules; Reaction of the molecules; Drawbacks of mechanical models as compared to graphical models; Co-ordinate systems two – matrix, potential energy surface; Postulates of quantum mechanics, Electronic structure calculations, Ab initio, Semi-empirical and Density functional theory calculations, Molecular size versus accuracy; Approximate molecular orbital theories.

UNIT II:

Molecular Modeling by Homology, construction of frame work, selecting variable regions, Back bone and side chain placement and refinement, Optimization and validation of protein models. Threading and Ab-initio modeling, Ramchandran plot.

UNIT III:

Introduction to QSAR for lead module: Linear and nonlinear modeled equations, Biological activities, Physicochemical parameters and Molecular descriptors, Application of QSAR modeling in drug discovery.

UNIT IV:

Molecular Mechanisms: Introduction to Force field, Use of various parameters for force field calculation (Bond length, angle angle, torsion angle, Electrostatic interaction, Vander waals interactions, Miscellaneous interaction); Introduction Molecular Dynamics using simple models, Dynamics with continuous potentials, Constant temperature and constant dynamics, Conformation searching, Systematic search, Applications to protein folding.

UNIT V:

3D pharmacophores modeling, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies; 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility.

Course Learning Outcomes (CLOs):

CO1: Explain the various stages of drug discovery
CO2: Learn the concept of bioisosterism and drug resistance
CO3: Learn the concept of pharmacophore and modelling techniques
CO4: Explain the various techniques in Virtual Screening

Reference books:

(i) Molecular Modelling: Principles and applications byA. Leach

(ii) Molecular Modelling by Hans Peter, Heltje & Gerd Folkens, VCH

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

S. NO. **LIST OF EXPERIMENT**

1. Isolation of RNA and its estimation by orcinol method

2. Isolation of plasmid DNA and its estimation by diphenylamine reaction

3. Elution of plasmid DNA from agarose gel

4. To perform restriction digestion of λ DNA

5. Dephosphorylation of restriction enzyme digested vector pUC18

6. To make bacterial cells competent for transformation

7. To perform of transformation of the desired bacterial strain with plasmid DNA

8. Screening of transformed colonies by X gal and IPTG

9. Verification of cloning by colony PCR and screening of the positive colonies

10. To perform a Southern Blotting for identification of desired DNA in a pool DNA samples

11. To perform ligation of λ EcoRI digest using T4DNA ligase

LIST OF EXPERIMENTS

1. Determine the growth patterns and specific growth rate of E. coli
2. Determine the effect of peptone concentration on *E .coli* growth
3. Fermentative production of Penicillin Antibiotics using *Penicilium chrysogenum*
4. To study the induction effect of β-galactosidase enzyme in *E. coli.*
5. Upstream and Downstream of bioprocess for the production of Citric acid by As spergillusniger.
6. Citric acid production from whey with glucose as supplementary carbon source by Spergillusniger.
7. Microbial production of citric acid by solid state fermentation process
8. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
9. Fermentative production of Ethanol using Saccharomyces cerevisiae

S.NO. **LIST OF EXPERIMENTS**

1. Retrieving sequence data from Entrez

2. Locating the chromosome of a Gene

3. Retrieve gene expression data from GEO

4. Retrieving articles using PubMed

5. Finding ORF of a Given Sequence

6. Retrieving structural data of a protein using PDB database

7. Retrieving Motif Information of a Protein Using Prosite

SEMESTER VI

Course Code: PCC BT 601 **Course Name**: Bioprocess Engineering II
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

To give students a solid foundation in biology and chemistry. To develop analytical and critical thinking skills in biological phenomena through scientific methods. Student will be prepared for understanding further **courses** related to **biochemical engineering**. Improvement in analytical skills.

Course Description:

This includes study of the **engineering** concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals.

Course Contents:

UNIT I: **Microbial growth and Media preparation:**
Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

UNIT II: Sterilization:
Concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.

UNIT III: Ideal Reactor Operation:
Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors.

UNIT IV: Role of diffusion in Bioprocessing:
Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

UNIT V: Bioreactor control mechanism:
Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.

Course Learning Outcomes (CLOs):

CO1. Students will gain knowledge of bioreactor
CO2. Students will understand the application and functioning of bioreactors
CO3. This course will make the students to understand the downstream procedure and fermenter waste treatment

Text books:

(i) Principles of Microbe and cell cultivation- S. John Pirt, John Wiley & Sons
(ii) Bioprocess Engineering Principles by P. M. Doran, Academic Press
(iii) Hand Book Of Bioengineering- Skalak R &ShuChien, McGraw- Hill

Reference books:

(i) Biochemical Engineering Fundamentals by Bailey &Ollis, McGraw-Hill College Publishers
(ii) Chemical Engineering: An Introduction by Morton Denn, Cambridge University Press
(iii) Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 602

Course Name: Plant Biotechnology

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The course is beneficial for students to have learning important milestones in the plant tissue culture. Understanding the concepts and principles of Plant tissue culture. Learning the techniques of sterilization and monitoring method of sterilization. Knowledge on environmental applications of genetic engineering through bioremediation.

Course Description:

The goal of this course is to introduce biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

Course Contents:

UNIT I:
Introductory history of plant biotechnology: Laboratory organization; Principles of Plant Tissue Culture. Concepts of totipotency, explants, inoculums, acclimatization. Nutrition of plant cells; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents. An appraisal of different media, selection of media, Sterilization of the media. Hormones: Auxins, Cytokinins, Gibberellins, Abscisic Acid, Ethylene etc. Explant preparation and Surface sterilization. Basic procedure for Aseptic Tissue transfer.

UNIT II:
Culture of plant materials- explants selection and technique of culturing. Organogenesis, Embryogenesis, Somaclonal variation, germiclonal variation. Establishment, growth and maintenance of Callus and cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field. Tissue and organ culture; Cellular differentiation and regulation of morphogenesis; Somatic embryogenesis; Control of organogenesis and embryogenesis; Single cell culture

UNIT III:
Haploid production: Androgenesis; Anther and microspore culture; Gynogenesis; Embryo culture and rescue in agricultural and horticultural corps; Protoplast isolation; Culture– regeneration; Somatic hybrid-cybrids; In vitro selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions; Micropropagation: Application of micropropagation in agriculture and forestry. Meristem culture and virus elimination; Shoot tip culture.

UNIT IV:
Improved crop varieties through somaclonal variation in invitro cultures. Application of tissue culture for crop improvement in agriculture, horticulture and forestry. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture production of secondary metabolites and other industrial products.

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UNIT V:

Genetic transformation using Ti plasmid Manipulation of gene expression in plants; Production of marker free transgenic plants. Developing insect-resistance, disease- resistance, herbicide resistance plants. Genetic manipulation of flower pigmentation, developing quality of seed storage, Provitamin A, iron proteins in rice, modification of food plant taste and appearance, yield increase in plants.

Course Learning Outcomes (CLOs):

CO1. Students will learn the principals and technical advances behind the in vitro culture of plant cells and rDNA techniques

CO2. Students will learn the applications of plant transformation for improving the productivity and performance of plants under biotic and abiotic stresses

CO3. Students will understand the use of antisense technologies for improvement of crop plants

Text books:

(i) Hamish A, Collin & Sue Edwards: Plant Cell Culture, BIOS Scientific Publishers
(ii) Razdan M K: An Introduction to Plant Tissue Culture, Science Publishers

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC BT 603 **Course Name**: Bioinformatics II

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

A student completing a major in Bioinformatics shall be able to apply: knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. existing software effectively to extract information from large databases and to use this information in computer modeling

Course Description:

This **course** provides an in-depth exploration of **bioinformatics** analysis of genomic data and the different approaches to mapping and aligning genome sequence data. You will also learn about programming and scripting along with techniques for the detection and analysis of genomic changes.

UNIT I:

Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis

UNIT II:
Basics of RNA Structure prediction and its limitations, Features of RNA Secondary Structure, RNA structure prediction methods: Based on self- complementary regions in RNA sequence, Minimum free energy methods, Suboptimal structure prediction by MFOLD, Prediction based on finding most probable structure and Sequence co-variance method. Application of RNA structure modeling

UNIT III:
Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Nonparametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K- mean).

UNIT IV:
Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis.

UNIT V:
Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) &Pharmacokinetics (ADME), Lipinski's rule of five, Pharmacogenomics

Course Contents:

Course Learning Outcomes (CLOs):

CO1. Students will be able to understand and describe and use the biological databases, perform structured query and analyze and discuss the results in biologically significant way.

CO2. Students will acquire knowledge of computer languages- PERL,C, SQL and JAVA and to write programs to solve biological problems

CO3. Students will be able to explain principle, algorithm and different methods of sequence alignments as well as execute alignments to address research problems

CO4. Students will become familiar with a wide variety of bioinformatics tools and softwares and apply these to conduct basic bioinformatics research and thus develop platform for molecular biology experiments

Text books:

(i) Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science

(ii) D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring HarbourLabpress

(iii) Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.

(iv) Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.

Reference books:

(i) Purifing Protein for Proteomics, Richard J. Sinpson, I.K. International Pvt. Ltd.

(ii) Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co., 1997. 18/ 24

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 31
Course Name: Animal Biotechnology
Course Credit Hour: 3Hr
Total Contact Hour: 30hr

Course Objective: The application of biotechnology to animals will be examined. Challenges facing the intensive and extensive livestock industries, as well as wildlife management and conservation, will be discussed and debated in the context of biotechnologies that may be applied. Problems specific to horses and companion animals will be also considered. The contribution of biotechnology to laboratory animal models for human and animal disease will be addressed.

Course Description: The use of biotechnology for animal related issues such as food safety, disease control and biosecurity will be considered. A range of genetic, immunological and reproductive technologies will be introduced with some practical exposure. The integration of these technologies to improve animal production, health and welfare will be explored.

Course Contents:

UNIT I:
Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

UNIT II:
Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants

UNIT III:
Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins

UNIT IV:
Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring

UNIT V:
Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell

lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of protooncogenes

Course Learning Outcomes (CLOs):

CO1: Describe the limitations and challenges facing the animal industries and disciplines
CO2: Describe the various biotechnologies available to the animal related fields
CO3: Explain how developments in biotechnology may have applications in those fields
CO4: valuate and discuss public and ethical concerns over the use of animal biotechnology

Text books:

(i) B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell
(ii) G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO
(iii) I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International

Reference books:

(i) Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press
(ii) Animal cell culture: Ian Freshney

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 32 **Course Name**: Biomarker & Diagnostics

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective: The objective of course domain requires the identification and the clinical validation of a huge number of **biomarkers** to predict disease **course**, to monitor disease evolution, to identify different sub-populations of patients, and to predict and monitor patient response to most of therapies

Course Description: This course Biomarkers and Diagnostics is designed to be a terminal degree with the graduate having strong prospects for immediate employment in industry.

Course Contents:

UNIT I:

Introduction to Molecular Diagnostics: History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario, Cellular Complexity: Cell components, Cell Differentiation, Cellular communication – endocrine signaling, paracrine signaling and autocrine signaling, contact dependent and synaptic communications, Intracellular networks – transport pathways, signaling pathways and metabolic networks. Eukaryotic Cell Control System and their Components, Intracellular cell cycle control system, Extracellular Cell Cycle Control System, Regulation of Cell Growth and Apoptosis, Genetic and epigenetic factors that regulate these pathways, their abnormalities that alter the pathways and cellular functions.

UNIT II:

Molecular Oncology Mitochondrial disorders: Cancer – Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing

UNIT III:

Biomarkers in disease diagnostics: FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour& cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders

UNIT IV:

Chromosomes, Human disorders, and Cytogenetic analysis: Structure, types and organization; Chromosome organization, Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Structural and Numerical aberrations and its consequences. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; function, and diseases. Uniparental disomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.

UNIT V:

Genomic instability, Chromosome mapping & Genome plasticity: Common fragile sites and methods of induction, Heritable fragile sites and FXS. Genomic Instability, mechanism and diseases. Trinucleotide Repeats; Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps, Relation to the probability of recombination, Pedigree analysis with genetic markers and overview of human genomProject

Course Learning Outcomes (CLOs):

CO1: To understand Biomarkers are used in research and clinical practice for:
CO2: Students will be able to diagnose diseases or predicting risks of disease,
CO3: Monitoring healthy people to detect early signs of disease,
CO4: Targeting specific groups of people for whom a particular drug may be useful,

Text books:

(i) Molecular biology of the cell. Bruce Alberts, 6th Edition
(ii) Principles of tissue engineering. Robert Lanza. Elsevier Publications
(iii) Introduction to Tissue engineering, applications and challenges. Ravi Birla.Wiley Publications

Reference books:

(i) Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
(ii) Cell and Molecular Biology: De Robertis EDP and De Robertis EMF
(iii) An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 33

Course Name: Food Biotechnology

Course Credit Hour: 3Hr

Total Contact Hour: 30hr

Course Objective:

The general aim of this subject is to provide the student with the transversal and specific capacities about the theoretical and practical aspects of the different biotechnological processes underlying the Food transformation, as well as those usually used by the food industry with the objective of improving production.

Course Description:

The main component of Food Biotechnology is food processing which refers to the phenomenon of changing the raw elements into edible food. To apprehend in simpler terms, Food Biotechnology involves the use of technology for efficient manufacturing, processing, treatment, preservation and distribution of food products.

Course Contents:

UNIT I:

History of Microorganisms in food: Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of foods that affect microbial growth. Basic principles of the equipment involved in the commercially important food processing methods and unit operations

UNIT II:

Microorganisms in food: spoilage of fresh meats and poultry, processed meats, seafood's, fruits and vegetables. Fermented food products, Medical foods, Probiotics and health benefits of fermented milk and foods products. Dehydrated Foods, Enteral Nutrient Solutions (Medical Foods), Single-Cell Protein. Starter cultures, Production process of cheeses, beer, wine and distilled spirits. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.

UNIT III:

Determining Microorganisms and/or their Products in Foods: Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms. Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods. Common Food borne diseases. Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.

UNIT IV:

Food Preservation: Food preservation by various methods especially Irradiation, Characteristics of radiations in food preservation, principles underlying the destruction of microorganisms by Irradiation. Application of radiations in food (processing for irradiation). Radappertization, Radicidation, and Radurization of Foods. Effect of Irradiation on Food quality and storage ability. Miscellaneous Food

Preservation Methods: High- Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Mano thermosonication (Thermo-ultra-sonication).

UNIT V:

Indicators of Food Safety and Quality: Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling. The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria. Food borne intoxicants and mycotoxins.

Course Learning Outcomes (CLOs):

CO1: Apply the scientific method to resolving problems.
CO2: Design experiments and interpret the **results**.
CO3 Develop individual **learning** strategies and planning and organization skills.

Text books:

(i) Frazier, W.S. and Weshoff, D.C., 2017. Food Microbiology, 5th Edn., McGraw Hill Book Co., New York.
(ii) Mann &Trusswell, 2007. Essentials of human nutrition.3rd edition. oxford university press

Reference books:

(i) Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi
(ii) Lindsay, 1988. Applied Science Biotechnology.Challenges for the flavour and Food Industry.Willis Elsevier

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 34 **Course Name**: Entrepreneurship In Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The purpose of the course is that the students acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities, to develop the ability of analyzing. It also develops the students' ability of analyzing various aspects of entrepreneurship especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development and, finally, to contribute to their entrepreneurial and managerial potentials.

Course Description: Topics of this course include an overview of the global biotechnology industry, idea generation, business plan formulation, intellectual property protection, funding, personnel management including board composition, regulatory body interaction and company exits.

Course Contents:

UNIT I:
Entrepreneur - Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Development of Entrepreneurship steps in entrepreneurial process, Biotech Entrepreneurship in India, Identification of Business Opportunities, Qualities, skills and attributes that successful biotech entrepreneurs possess. Case studies of successful and unsuccessful bio-entrepreneurs

UNIT II:
Business development in biotechnology - Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources , project location, end product, quality issues, etc) Basic principles and practices of management - Definition, concepts and application; Organization types, coordination, control and decision making in management

UNIT III:
Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors. Marketing, Marketing research- concept and techniques, Considerations in establishment of biotechnological start-up - Different models of biotechnological start-ups. The budget for a biotechnological start-up company. Seed capital raising for a biotechnological startup company

UNIT IV:
Role of government and schemes, financial institutions in fostering Bio- entrepreneurship, Skills in bio-Entrepreneurship-Personality and attitude, Organizational behavior, Leadership, Principles of effective communication Body language, public speaking, presentations, business proposal writing.

UNIT V:
Biotechnology: emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research

Organization, marketing consultancy, bio- learning module. Ethics and IPR in biotech-Industries - Fundamentals of ethics in business, Ethical dilemmas in biotech industry, IPR- Introduction, Forms of IPR.

Course Learning Outcomes (CLOs):

After the completion of the course, the students will be able to:
CO1. Have the ability to discern distinct entrepreneurial traits
CO2. Know the parameters to assess opportunities and constraints for new business ideas
CO3. Understand the systematic process to select and screen a business idea

Text books:

(i) Biotechnology Entrepreneurship1st Edition.Starting, Managing, and Leading Biotech Companies.CraigShimasaki. Academic Press.2014

(ii) Introduction to Biotech Entrepreneurship: From Idea to Business. A European Perspective. Matei**,** Florentina**,** Zirra, Daniela (Eds.).Springer nature publication.2019

Reference books:

(i) Biotechnology Entrepreneurship from Science to Solutions -- Start-Up, Company Formation and Organization, Team, Intellectual Property, Financing, Part 1st Edition. Michael L. Salgaller. Logos Press (August 25, 2010)

(ii) How to Start a Biotech Company. SourishSaha et.al., Independently published (September 4, 2019)

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

S. NO.	**LIST OF EXPERIMENT**
1.	Determine the growth patterns and specific growth rate of *E.coli*
2.	Determine the effect of peptone concentration on E.coli growth
3.	Determination of specific thermal death rate constant (Kd) for *E.Coli*
4.	Determine the effects of temperature & pH on Psuedomonasputida
5.	Upstream and Downstream of bioprocess for the production of Citric acid by spergillusniger
6.	Citric acid production from whey with glucose as supplementary carbon source by
7.	Upstream and Downstream of bioprocess for the production of α-amylase by spergillusniger Aspergillusnudulans
8.	Estimation of volumetric liquid mass transfer coefficient (KLa) using sodium sulphite method
9.	Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10.	Computational Design of Fermentative Process for L-lysine production

PLANT BIOTECHNOLOGY LAB **P**
Subject code: PLC BT 622 **2**

S. NO. **LIST OF EXPERIMENT**

1. Preparation of Stocks solution for plant tissue culture media.
2. Preparation of MS/B5 medium (semi-solid) and sterilization.
3. Explant selection, preparation and surface sterilization.
4. To learn culturing, sub culturing and maintenance using selected explants.
5. Initiation of in vitro cultures through axillary bud induction.
6. Initiation of callus cultures from different explants.
7. Preparation of artificial seed/synthetic seed for conservation of germplasm.
8. Extraction of DNA/RNA from plants and its estimation.
9. Isolation and characterization of plant secondary metabolites from selected medicinal plants.
10. Extraction of proteins from plants and its estimation.

BIOINFORMATICS II LAB **P**
Subject code: PLC BT 623 **2**

S. NO. **LIST OF EXPERIMENT**

1. Identification of Distantly related homologous sequences of a given query protein sequence using PSI-BLAST
2. Construct Phylogenetic tree of five evolutionary related protein/nucleotide sequences
3. Prediction of secondary structure of RNA using any web server.
4. Construction and analysis of Ramachandran Plot using any suitable web server
5. Align two homologous protein structure and calculation the RMSD for the superposition result
6. Comparative assessment of best available tools for genome annotation
7. Construction of restriction maps for various vectors used in genetic engineering using tool “NEB cutter”.
8. Primer Design: Construct primers for the given DNA sequence using any suitable web based tool.
9. Generate 2D QSAR model of a set of legend descriptor data

Course Code: HSMC 401 **Course Name:**

Course Credit: 3 **Total Contact Hours:** 20hr

Course Objective(s):

- To disseminate knowledge on patents, patent regime in India and abroad andregistration aspects
- To make students aware about current trends in IPR and Govt. supports in promotingIPR
- To classify the role of regulatory committees in controlling the risk

Course Content:

Unit I:

Intellectual Property Rights: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies.

Unit II:

Biosafety-Regulatory Framework for GMOs in India & at International Level: Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBSC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment andForests Notification, (1989).

Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol.

Understand the legal steps involved in progressing a new drug to market. Grasping the current regulatory acts and safety norms of the modern pharmaceutical industries

Unit III:

Bioethics: Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.

Text Books/References*:*

Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New Age International publishers.

E-resources:

Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

World Intellectual Property Organization. (2004). WIPO Intellectual Property Handbook. (https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

Course Outcomes:

CO1. The students shall get an adequate knowledge on patent and copyright. This provide further way for developing their idea or innovations.

CO2. Identify the role of regulatory committees in controlling the risk.

CO3. Students should get enough information on ethical issues linked to research on animal models, transgenic, clinical trials.

CO4. Students to consider Intellectual Property (IP) as a career option as IP Counsel/Patent Examiner/Patent agent.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

BACHELOR OF TECHNOLOGY

Automobile Engineering

Course Curriculum

FOR B.TECH-ME COURSE
(Effective from Academic session 2018-2019)

Introduction- Automobile engineering is an engineering branch that combines engineering physics and mathematics principles with materials science to design, analyze, manufacture, and maintain mechanical and automobile systems. It is the branch of engineering that involves the design, production, and operation of machinery. Apply basic knowledge of mathematics, science and engineering principles to solve technical problems. Design and analyze a system component, or process to meet desired needs in Mechanical Engineering. Design a system and conduct experiments to find suitable solution in the field of mechanical engineering.

Program Educational Objectives (PEOs)

The Department of Mechanical Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of Mechanical Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Programme specific outcome (PSO)

- PSO1: Graduates of the program will achieve excellence in product design, thermal engineering and manufacturing system by acquiring knowledge in mathematics, science and designing principles
- PSO2: Graduate will be able to analyze, interpret and provide solutions to the real life mechanical engineering problems.
- PSO3: Graduate will develop an approach to solve multidisciplinary problems of manufacturing and allied industries
- PSO4: Graduate will develop an approach to solve multidisciplinary problems of manufacturing and allied industries.
- PSO5: Research Capability: Students at the time of graduation will be able to apply domain knowledge and expertise for enhancing research capability to transform innovative ideas into reality

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B.Tech:

- Every semester shall offer a minimum of **18 credits** and a maximum of 24 **credits**.
- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. tech Degree Course could vary from a **minimum of 158** credits to a **maximum of 165** credits.
- All courses of study put together would engage the students for a **minimum of 26 periods** or hours of study a week and a **maximum of 30 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
   (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
   (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate's proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits	Percentage
1	Humanities and Social Sciences including Management courses	12	
2	Basic Science courses	24	
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	29	
4	Professional core courses	49	
5	Professional Elective courses relevant to chosen specialization/branch	18	
6	Open subjects – Electives from other technical and /or emerging subjects	12	
7	Project work, seminar and internship in industry or elsewhere	15	
8	Mandatory Courses	0	
		*159	

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	15	5.5	20.5
2nd	12	5.5	17.5
3rd	22	0	23
4th	19	6	19
5th	18	3	21
6th	18	2	20
7th	14	7	21
8th	12	6	18
Total	110	48	160

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
PCC : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

COURSE STRUCTURE

FIRST SEMESTER

S.No	Course Code	Subject	Period			EvaluationScheme					Total Credits
						SessionalExam			External	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC101	Physics-I	3	1	0	20	20	40	60	100	4
2	BSC102	Mathematics-I	3	1	0	20	20	40	60	100	4
3	HSMC101	English	2	0	0	20	20	40	60	100	2
4	ESC101	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	ESC102	Engineering Graphics & Design	1	0	0	20	20	40	60	100	1
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	20	20	40	60	100	1.5
2	HSMC101P	English Lab	0	0	2	20	20	40	60	100	1
3	ESC101P	Basic Electrical Engineering Lab	0	0	2	20	20	40	60	100	1
4	ESC102P	Engineering Graphics and Design Lab	0	0	4	20	20	40	60	100	2
5	MC102P	Induction Program	0	0	0	20	20	40	60	100	0
Total Credits											**20.5**

Second Semester

S.No	Course Code	Subject	Period			EvaluationScheme					Total Credits
						SessionalExam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC104	Mathematics-II	3	1	0	20	20	40	60	100	4
2	BSC103	Chemistry-I	3	1	0	20	20	40	60	100	4
3	ESC103	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
4	ESC104	Workshop Practices	1	0	0	20	20	40	60	100	1
5	MC-I	Constitution of India	0	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC102P	Chemistry-I Lab	0	0	3	20	20	40	60	100	1.5
2	ESC102P	Workshop Practices	0	0	4	20	20	40	60	100	2
3	ESC101P	Programming for Problem Solving Lab	0	0	4	20	20	40	60	100	2
Total											**17.5**

Third Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						SessionalExam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	BSC201	Physics-II	3	1	0	20	20	40	60	100	4
2	BSC202	Mathematics-III	3	1	0	20	20	40	60	100	4
3	BSC203	Biology	3	0	0	20	20	40	60	100	3
4	ESC201	Basic Electronics Engineering	3	1	0	20	20	40	60	100	4
5	ESC202	Engineering Mechanics	3	1	0	20	20	40	60	100	4
6	PCC-AE 201	Thermodynamics	3	1	0	20	20	40	60	100	4
Total											**23**

Fourth Semester

S.No	Course Code	Subject	Period			EvaluationScheme					Total Credit
						SessionalExam			External Exams	Subject Total	
			L	T	P	CA	TA	Total			
1	PCC-AE 202	Applied Thermodynamics	3	1	0	20	20	40	60	100	4
2	PCC-AE 203	Fluid Mechanics & Fluid Machines	3	1	0	20	20	40	60	100	4
3	PCC-AE 204	Strength of Materials	3	1	0	20	20	40	60	100	4
4	PCC-AE 205	Material Engineering	3	0	0	20	20	40	60	100	3
5	PCC-AE 206	Instrumentation and Control	3	1	0	20	20	40	60	100	4
Total											**19**

Fifth Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	**PCCAE 301**	**Automotive transmission Systems**	4	0	0	20	20	40	60	100	3
2	**PCCAE 302**	**IC Engines**	3	1	0	20	20	40	60	100	4
3	**PCC ME 302**	**Solid Mechanics**	3	1	0	20	20	40	60	100	4
4	**PCC ME 303**	**Manufacturing Process**	3	1	0	20	20	40	60	100	4
5	**HSMC 301**	**Industrial Psychology**	3	0	0	20	20	40	60	100	3
6	**MC 2**	**Constitution of India**	0	0	0	20	20	40	60	100	0
PRACTICALS											
1	**PCCAE 304**	**I.C. ENGINES LAB**	0	0	2	0	0	40	60	100	2
2	**PROJ-AE-306**	**Project 1**	0	0	1	20	20	40	60	100	1
Total										**800**	**21**

Sixth Semester

S. No.	Course Code	Subject	Period			Evaluation Scheme					Total Credits
						Sessional Exam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	PCC-AE 307	Automotive Chassis and Auto System Design	4	0	0	20	20	40	60	100	4
2	PCC-AE308	Automotive Control Engineering	3	1	0	20	20	40	60	100	4
3	PCC-AE309	Automotive Emission and IC Engine Tribology	4	0	0	20	20	40	60	100	4
4	PEC AEL- 325	Elective-I – Operations Research	3	0	0	20	20	40	60	100	3
5	PEC AEL- 326	Elective-II – Computer Aided Designing	3	0	0	20	20	40	60	100	3
PRACTICALS											
1	PCC-AE-310	Automotive Chassis and Auto System Design Lab	0	0	2	-	-	40	60	100	1
2	PCC-AE-311	Automotive System and Pollution Lab	0	0	2	-	-	40	60	100	1
Total Credits											**20**

Practical Training/ Industrial Training: 4 - 6 weeks*

Seventh Semester

S.No	Course Code	Subject	Period			EvaluationScheme					Total Credits
						SessionalExam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	PCC-AE401	Vehicle Aerodynamics and Vehicle Body Engineering	3	1	0	20	20	40	60	100	4
2	PEC-AEL 402	Microprocessor application in Automobile	3	1	0	20	20	40	60	100	4
3	PCC-AEL421	Elective-III	3	0	0	20	20	40	60	100	3
4	OEC401	Open Elective	3	0	0	20	20	40	60	100	3
PRACTICALS											
5	PCC-AE403	Body Engineering Lab	0	0	2	-	-	40	60	100	1
6	PCC-AE403	Seminar	0	0	2	-	-	40	60	100	2
Total Credits											**17**

Eighth Semester

S.No	Course Code	Subject	Period			Evaluation Scheme					Total
						SessionalExam			External Exam	Subject Total	
			L	T	P	CA	TA	Total			
1	PEC-AEL 431	Elective V	3	0	0	20	20	40	60	100	3
2	PEC-AEL 432	Elective VI	3	0	0	20	20	40	60	100	3
3	OEC402	Open Elective-IV	3	0	0	20	20	40	60	100	3
4	OEC403	Open Elective V	3	0	0	20	20	40	60	100	3
PRACTICALS											
1	PROJ-AE 404	Project-IV	0	0	12	-	-	200	300	500	6
Total											**18**

Elective I &II AEL321-325

Elective I &II PEC-AEL321-325 PEC-

AEL321 IC Engine (6^{th}sem) PEC

AEL322 Mechatronics (6^{th}sem)

PEC-AEL323 Microprocessor in Automation (6^{th}sem)

PEC-AEL 324 Composite Materials (6^{th}sem)

PEC-AEL 325Computer Aided Design (6^{th}sem

Elective III & IV PEC-AEL421-425

PEC-AEL 421 Refrigeration and Air Conditioning (7^{th}sem)

PEC-AEL 422 Finite Element Analysis (7^{th}sem)

PEC-AEL 423 Power Plant Engineering (7^{th}sem)
PEC-AEL 424 Gas Dynamic & Jet Propulsion (7^{th}sem) PEC-
AEL 425 Process planning & cost estimation (7^{th}sem)

Elective V & VI PEC-AEL 431-435

PEC-AEL 431 Principles of Management (8^{th}sem)
PEC-AEL 432 Automobile Engineering (8^{th}sem)
PEC-AEL 433 Design of transmission system (8^{th}sem)
PEC-AEL 434 Energy conservation and Management (8^{th}sem)
PEC-AEL 435 Total Quality Management (8^{th}sem)

Open Elective II,III,IV,V

Open Elective II
1.Operation Research
2.Economics
3.Financial Accounting

Open Elective III,IV,V

1. Nanotechnology and surface engineering
2. Entrepreneurship DevelopmentProgram
3. Design of bearings and shafts
4. Mechanical System Design
5. VibrationEngineering
6. Human Resource Management

SEMESTER-I

DETAILED CURRICULUM CONTENTS

Course Code: BSC101 **Course Name:** Mathematics-I
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs
Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Description:

- In this course we apply to differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions and discuss the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- We shall also learn the tool of power series and Fourier series for learning advanced Engineering Mathematics and deal with functions of several variables that are essential in most branches of engineering and the essential tool of matrices and linear algebra in a comprehensive manner

Course Contents:

Unit 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Unit 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

- CLO-1: Apply to differential and integral calculus to notions of curvature and to improper integrals and its applications in engineering problems
- CLO-2: Fundamental to application of analysis to Engineering problems by mean value theorems.
- CLO-3: Apply the tool of power series and Fourier series for learning advanced Engineering Mathematics.

- CLO-4: Discuss problem and application of Multivariable Calculus.
- CLO-5: Apply tool of matrices and linear algebra in a comprehensive manner

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
(iii) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:

https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%

Total Internal Assessment	**- 40%**

Course Code: BSC102

Course Name: Chemistry-I

Course Credit Hour: 4hr

Total Contact Hour: 45hr

Course Objective:

The objectives of the course are

1. To develop the interest among the students regarding chemistry and their applications in engineering. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.
2. To emphasize on learning microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
3. To understand principles of different spectroscopic techniques and its applications. Bulk properties and processes will be analyzed using thermodynamic considerations.
4. To outline periodic properties, stereochemistry, chemical reactions and synthesis.
5. To teach of experiments illustrating the principles of chemistry that have been learnt so far, as well as others relevant to the study of science and engineering.
6. To develop an intuitive understanding of chemistry by emphasizing the related branches of engineering.
7. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.

Course Description:

- The course introduces fundamental concepts chemistry including Atomic and molecular structure, Spectroscopic techniques and applications, Intermolecular forces and potential energy surfaces , Use of free energy in chemical equilibrium, Periodic properties, Stereochemistry and Stereochemistry . This subject also laid down the groundwork for subsequent studies in the fields such as chemical, mechanical, civil, environmental, electrical and electronics engineering etc.

Course Contents:

Module 1: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and their applications for onjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi-centre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules. Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques, Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Module 6: Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.

Module 7: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):

The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomers, Understand the relationship between biological properties of pairs of enantiomers or diastereomer.
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

  - Distinguish between different kinds of isomers

Text books:

- B. H. Mahan, "University chemistry", Addison-Wesley Publishing Company.
- M. J. Sienko and R. A. Plane, "Chemistry: Principles and Applications", McGraw- -ill International.
- C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw Hill Education.

Reference books:

- B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry" (NPTEL).
- K. P. C. Volhardt and N. E. Schore, " Organic Chemistry: Structure and Function" Freeman.

Online links for study & reference materials:

https://nptel.ac.in/courses/104/103/104103071/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: HSMC101 **Course Name:** English
Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

- The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Description:

- This course introduces the fundamental of communication skills, writing skills presentation skills and interview skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills.

Course Contents:

Unit 1: Vocabulary Building (4 lectures)

The concept of Word Formation, Root words from foreign languages and their use in English Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

Unit 2: Basic Writing Skills (4lectures)

Sentence Structures, use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents Techniques for writing precisely

Unit 3: Identifying Common Errors in Writing (4 lectures)

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions Redundancies Clichés

Unit 4: Nature and Style of sensible Writing (4 lectures)

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

Unit 5: Oral Communication **(4 lectures)**

(This unit involves interactive interaction)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentation.

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.
- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

- Raman, Singh – Business communication – Oxford Press
- Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
- Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
- Practical English Usage. Michael Swan. OUP. 1995.
- Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Reference books:

- English Phonetics & Phonology, P. Roach, Cambridge University Press, London
- Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Online links for study & reference materials:

- https://nptel.ac.in/courses/109/106/109106094/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 4**

Course Code: ECS101 **Course Name:** Programming for Problem Solving

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- The course aims to provide exposure to problem –solving through programming. It aims to train the student to the basic concept of the C –programming language. This course involves a lab component which is designed to give the student hands –on experience with the concept.

Course Description:

- This course introduces the fundamental concepts of computer and programming and provides comprehensive introduction to programming in C. Topic includes introduction to programming, Arrays, Basic Algorithms, Functions, Recursion, Structure and Pointers.

Course Contents:

Unit 1: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) ,Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit 2: Arithmetic expressions and precedence

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays

Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms ,Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition Required)

Unit 5: Function

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Unit 6: Recursion

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7: Structure

Structures, Defining structures and Array of Structures.

Unit 8: Pointers

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9: File handling (only if time is available, otherwise should be done as part of the lab)

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.
- **CLO-2:** Test and execute the programs and correct syntax and logical errors.
- **CLO-3:** Implement conditional branching, iteration and recursion.
- **CLO-4:** Use arrays, pointers and structures to formulate algorithms and programs.
- **CLO-5:** Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text books:

(iv) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
(v) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
(vi) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

- Brian W. Kernighhan and Dennis Ritchie, The C Programming Language, Prentice Hall of India

Online links for study & reference materials:

https://nptel.ac.in/courses/106/104/106104128/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS

FIRST SEMESTER

Lab Code: ESC101P **Lab Name:** Programming for Problem Solving
Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

Problems based on if-then-else structure:

1. If the three sides of the triangle are entered through the keyboard, write a program to check whether the triangle is isosceles or equilateral.
2. In a company an employee is paid under: If his basic salary is less then Rs.1500, then HRA=10% of basic salary and DA=90% of basic salary .If his salary is either equal to or above Rs 1500, then HRA=Rs 500 and DA= 98% of basic salary. If the employee's salary is input through the keyboard write a program to find his gross salary.
3. The current year and year in which the employee joined the organization are entered through the keyboard. If the no of years for which the employee has served the organization is greater than 3 then a bonus of Rs.2500/- is given to the employee. If the years of service are not greater than three, then the program should do nothing. Write a program to perform the said task.
4. Write a program to check whether a triangle is valid or not when the three angles of the triangle are entered through the keyboard. A triangle is valid if the sum of all the three angles is equal to 180 degree.
5. If cost price and selling price of item is input through the keyboard, write a program to determine whether the seller gas made profit or incurred loss. Also determine how much profit he made or loss he incurred.
6. In a company worker efficiency is determined on the basis of the time required for a worker to complete a particular job. If the time taken by the worker is between 2-3 hours, then the worker is said to be highly efficient. If the time required by the worker is between 3-4 hours, then the worker is ordered to improve speed. If the time taken is between 4-5 hours, the worker is given training to improve his speed, and if the time taken by the worker is more than 5 hours, then the worker has to leave the company. If time taken by the worker is input through the keyboard, write a program to find the efficiency of the worker.

Problems based on while loop and for loop:

1. Write a program to print the cube of any number provided by the user.
2. Make a program to calculate the simple interest for 3 sets of p, n, r using while and for loop.
3. Write a program to print the sum of all the digits from 1 to 10 using while loop.
4. Write a program to print the digit from 1 to100 using while and for loop.
5. Using for loop print the following pattern

    R=1 c=1 sum=2

    R=1 c=2 sum=3

    R=2 c=1 sum =3

    R=2 c=2 sum=4

6. Write a program to print the following pattern

```
*****     *         1
*****     **        12
*****     ***       123
*****     ****      1234
          *****     12345
```

7. Write a program to print the square and cube of any given number.

Problems based on 1-D Array, Array Manipulation, 2-D Array and String Operations:

1. Write a program to perform following operations on String(s) using a well-defined library function:
   - Find the length of the string.
   - Concatenate two strings
   - Compare two given strings
   - Copy the content of string to another string
2. Write a program to find average marks obtained by a class of 30 students in a test.
3. Write a program to find the maximum marks obtained by a student in 5 subjects.
4. Write a program to pick up the largest number from any 5 row by 5 column matrix.
5. Twenty five numbers are entered from the keyboard into an array. Write a program to find out how many of them are positive, how many of them are negative and how many of them are zeros.
6. Write a program to store n elements in an array and print all elements.
7. Write a program to compute the sum of all elements in an array.
8. Write a program to print the elements of an array in reverse order.

Problems based on Structures:

1. Write a program to enter name, price and page number of three books using structure.
2. Write a program to enter roll number and average marks of 3 students using structure.
3. Create a structure to specify data of customer in a bank. The data to be stored is: Account number, Name, Balance in Account. Assume maximum of 200 customers in the bank. Write a program to print name and account number of each customer with balance below Rs. 100.
4. A record contains name of cricketer, his age, number of test matches that he has played and the average runs that he has scored. Create an array of structures to hold records of 20 such cricketers.
5. There is a structure called employee that holds information like employee code, name, and year of joining. Write a program to create an array of structures and enter some

data into it. Then ask the user to enter current year. Display the names of those employees whose tenure is more than 3 years according to given year.

Problems based on Function, Pointer, Call by Value and Call by Reference

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.
4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers**.**
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

Problems based on Recursion, recursive functions, file handling operations and numerical method problems:

1. Write a program to writes records to a file using structure.
2. Write a program for reading a string from the file and display them on screen.
3. Write a program to copy the content of one file to another file.
4. Write a program to display contents of a file on screen.
5. Write a program to count Chars, space, tabs and new lines in a file.
6. Write a program to calculate factorial of any inputted number with recursion and without recursion.
7. Write a program to calculate Fibonacci Series using recursive call.
8. Write a program to calculate Ackerman Function for any two non-negative integers using recursion.

Lab Code: BSC104P **Lab Name:** Chemistry Lab

Course Credit Hour: 1.5 **Total Contact Hours:** 03

List of Experiments:

- Determination of Alkalinity in given water sample.
- Determination of Total hardness, Permanent hardness and Temporary Hardness of given Water Sample by using EDTA as standard solution.
- Determination of available chlorine in Bleaching powder.
- Determination of chloride Contents in given Water sample by using Mohr'sMethod.
- Determination of Iron Content in the given Ore by using external Indicator.
- pH metric titration.
- Viscosity of an addition polymer like Polyester by Viscometer.
- Determination of heat of neutralization of Hydrochloric acid and Sodiumhydroxide.
- Determination of amount of dissolve Oxygen in water.
- Separation of metal ions by paper chromatography.

SEMESTER-II

DETAILED CURRICULUM CONTENTS

Course Code: BSC102 **Course Name:** Physics

Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective: At the completion of this course, a student will be able to

1. Know about the development of modern Physics and the theoretical formulation of quantum mechanics.
2. Know the applications of quantum mechanics in solving physical problems.

Course Description: This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

Course Contents:

Unit I: Wave nature of particles and the Schrodinger equation (8 Lectures)

Introduction to Quantum mechanics, Wave nature of particles, Time independent and time dependent Schrodinger equation for wave function, Born interpretation, Probability current, Expectation values, Free particle wavefunction and wave packets, Uncertainty principle

Unit II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

Complex numbers Linear vector spaces Inner product Operators Eigen value problems Hermitian operators Hermite polynomials Legendre`s equation Spherical harmonics

Unit III: Applying the Schrodinger equation (15 Lectures)

Solution of stationary state Schrodinger equation for one dimensional problem Particle in a box Particle in attractive delta function potential Square well potential Linear harmonic oscillator

Numerical solution of stationary state Schrodinger equation for one dimensional problem for different potentials Scattering from a potential barrier and tunneling Examples like alpha decay, field ionisation and scanning tunnelling microscope Three dimensional problems: particle in three-dimensional box and related examples Angular momentum operator Rigid rotor Hydrogen atom ground state, orbitals, interaction with magnetic field spin Numerical solution stationary state Schrodinger equation for spherically symmetric potentials

Unit IV: Introduction to Molecular Bonding (4 Lectures)

Particle in double delta function potential Molecules (Hydrogen molecule, valence bond and molecular orbitals picture) Singlet/triplet states Chemical bonding Hybridization

Unit V: Introduction to Solids (7 Lectures)

Free electron theory of metals Fermi level, density of states Application of white dwarfs and neutron stars Bloch theorem for particles in a periodic potential Kronig-Penney model and origin of energy bands Numerical solution for energy in one dimensional periodic lattice by mixing plane waves

Course Learning Outcomes (CLOs):

After successful completion of this paper, the student will be well-versed in

- **CLO1.** Concepts of basis and operators
- **CLO2.** Both Schrodinger and Heisenberg formulations of time development and their applications
- **CLO3.** Solution of stationary state Schrodinger equation for one dimensional problem
- **CLO4.** Concepts of Molecules (Hydrogen molecule, valence bond and molecular orbitals picture)
- **CLO5.** Kronig-Penney model and origin of energy bands

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

- D. J. Grriffiths, Quantum Mechanics
- Richard Robinett, Quantum Mechanics
- Daniel McQuarrie, Quantum Chemistry

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

Course Code: BSC103

Course Name: Mathematics II

Course Credit Hour: 4hr

Total Contact Hour: 40hrs

Course Objective:

- The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Course Description:

- Applying the mathematical tools for need in evaluating multiple integrals and their usage, solutions of differential equations that model physical processes and the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Contents:

Unit 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Unit 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for *x* and Clairaut's type.

Unit 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm)

Unit 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.
- CLO-5: Integration of Vector Calculus.

Text books:

- Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Edition, Pearson,

Reference books:

- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
- D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiley India

Online links for study & reference materials:

https://nptel.ac.in/courses/122/107/122107036/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%
Total Internal Assessment	**- 40%**

Course Code: ESC102 **Course Name:** Workshop/Manufacturing Practices
Course Credit: 5.5 **Total Contact Hours:** 40hr

Course Objective:

- To familiarize with the basic manufacturing processes and to study the various tools and equipment.
- They will get hands-on training is given in different sections. Essentially student should know the labour involved, machinery or equipment necessary.
- To analyze time required to fabricate and also should be able to estimate the cost of the product or job work.

Course Description:

- Ability to prepare simple objects using machines and machine tools to make students aware of fundamental operations of manufacturing an engineering component, enhance visualization and motivate them to innovate.

Course Contents:

Module 1

Machine Shop: To make a machined-component using lathe with mild steel round bar or hexagonal bar comprising of common turning operations with reference to drawing given in the manual. Any one of the following jobs Jobs: Hex Bolt, Axle for cycle wheel, Jig Bush, a typical turning specimen.

Module II

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel.

Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

Module III

Carpentry Shop: To make a wooden joint with soft wood as per the drawing provided in the manual. Any one of the following jobs Jobs: T-Lap joint, Dove tail joint, Mortise & Tendon joint, Bridle joint.

Module IV

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual. Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.**Gas & Spot Welding** To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

Module V

Foundry Shop Introduction to foundry process like melting of metals, mould making, casting process and use of patterns to prepare of a component and significance of foundry. Demo of mould preparation.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able to achieve the following:

- Have Capability to identify hand tools and instruments for machining and other workshop practices.
- The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Text books:

- A course in Workshop Technology Vol I and Vol II by Prof. B.S. Raghuwanshi Dhanpat Rai & Co.(P) Ltd.
- Elements of Workshop Technology Vol I and Vol II by S.K. Hajara Choudhury, A.K. Hajara Choudhury & Nirjhar Roy; Media Promoters & Publishers Pvt. Ltd, Mumbai.

Reference books:

- Workshop Technology Part 1, Part2 & Part3 by W.A.J. Chapman; CBS Publishers & Distributors, New Delhi
- Kalpak Jian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
- Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008.
- Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
- Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Online links for study & reference materials:

http://ecoursesonline.iasri.res.in/course/view.php?id=86

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40**

Course Code: ESC104 **Course Name:** Basic Electrical Engineering
Course Credit: 5hr **Total Contact Hour:** 42hr

Course Objective:

- To introduce concept of D.C. circuits and A.C. circuits.
- To make the students understand and working of machines, transformer and components used for low voltage installation.

Course Description:

- This course introduces the fundamental concepts of circuits, machines and low voltage installation.

Course Contents:

Unit 1: DC Circuits
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit 2: AC Circuits
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Unit 3: Transformers
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit 4: Electrical Machines
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit 5: Power Converters
DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit 6: Electrical Installations (6 hours)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):
At the end of this course, students will demonstrate the ability

- CLO-1: Analyze basic electric and magnetic circuits.
- CLO- 2: working principles of electrical machines and power converters.
- CLO-3 :Understand the basic concept of components of low-voltage electrical Installations.

Text books:

- D. P. Kothari and I. J. Nagrath, " Basic Electrical Engineering", Tata McGraw Hill.
- D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill.

Reference books:

- L. S. Bobrow, " Fundamentals of Electrical Engineering", Oxford University Press.
- E. Hughes, "Electrical and Electronics Technology", Pearson.
- V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India.

Online links for study & reference materials:

https://nptel.ac.in/courses/108/108/108108076/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: AECCI | **Course Name:** Environmental Science
Course Credit Hour: 2hr | **Total Contact Hour:** 25

Course Objective:

- The Compulsory course on Environmental Science at Undergraduate level (AECCI) aims to train students to cater to the need for ecological citizenship through developing a strong foundation on the critical linkages between ecology-society-economy.

Course Description:

- Graduates will evolve into ecologically informed and socially responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Course Contents:

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies
- Scope and importance; Concept of sustainability and sustainable development

Unit 2: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem
  Physical (energy flow), Biological (food chains, food web, ecological succession) and
  Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological
  pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

Unit 3: Natural Resources

- Land resources and landuse change Land degradation, soil erosion and desertification
- Forest resources and causes of deforestation; impacts of mining and dam building on environment, forests, biodiversity and tribal populations
- Water resource: Use and over exploitation of surface and ground water, floods, drought conflicts over water (international & inter-state)
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs
- Case studies: National Solar Mission, Cauvery river water conflict etc

Unit 4: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

<u>Unit 5</u>: Environmental pollution

- Environmental pollution (Air, water, soil, thermal and noise): causes, effects and controls; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues etc

<u>Unit 6</u>: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

<u>Unit 7:</u> Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare
- Resettlement and rehabilitation of project affected persons; case studies
- Disaster management: floods, earthquake, cyclones and landslides
- Environmental movements: Chipko movement, Silent valley movement, Bishnois of Rajasthan, Narmada BachaoAndolan etc
- Environment justice: National Green Tribunal and its importance
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan)

Field work/ Practicals

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc. or any nearby lake or pond, explaining the theoretical aspects taught in the classroom

- Visit to any biodiversity park/ reserve forests/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (Urban/Rural/Industrial/Agricultural), Wastewater treatment plants
- Study of common plants, insects, birds and basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building and critical reasoning among students

Course Learning Outcomes (CLOs):

The course will empower the undergraduate students by helping them to:

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones..
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

- William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo, Environmental Science: A global concern, McGrawHill 2003 ¬
- William Cunningham, Mary Cunningham, Principles of Environmental Science: Seventh Edition, Mc Graw Hill 2014 UGC DOCUMENT ON LOCF ENVIRONMENTAL SCIENCE 24
- Rogers PP, Jalal, KF, Boyd JA, An introduction to sustainable development, Earthscan

Reference books:

- Roosa SA, Sustainable Development Handbook, CRC Press 2008 ¬
- Atkinson G., Dietz S., Neumayer E., Agarwala M, Handbook of Sustainable Development, Edward Elger, 2014 ¬
- Robbins P., Hintz J., Moore S.A., Environment and Society: A critical introduction, Wiley Blackwel 2014

Online links for study & reference materials:

https://www.hzu.edu.in/bed/E%20V%20S.pdf

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

LAB EXPERIMENTS
SECOND SEMESTER

Lab Code: BSC101P

Lab Name: Physics Lab

Course Credit Hour: 1.5hr

Total Contact Hour: 03

List of Experiments:

- Four Probe Setup
- Stefan`s Law
- Diode Valve Characteristics
- Frequency of A.C Mains
- Band Gap in a Semi-Conductor Diode
- P-N Junction Diode Characteristics
- Zener Diode Characteristics
- Transistor Common-Base Configuration
- Transistor Common-Emitter Configuration

Lab Code: ESC102P **Lab Name:** Workshop/Manufacturing Practice

Course Credit Hour: 2hr **Total Contact Hour:** 04

List of Experiments:

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
- CNC machining, Additive manufacturing
- Fitting operations & power tools
- Electrical &Electronics
- Carpentry
- Plastic molding, glass cutting
- Metal casting
- Welding (arc welding & gas welding), brazing

Lab Code: ESC104P **Lab Name:** Electrical Engineering Lab

Course Credit Hour: 1hr **Total Contact Hour:** 02

List of Experiments:

- Basic safety precautions. Introduction and use of measuring instruments – poltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify KCL and KVL in D.C.circuit
- To verify Superposition theorem
- To Verify The venin's Theorem
- To find resonance in series R-L-C circuit.
- Transformers: Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement).
- Torque Speed Characteristic of separately excited dc motor.
- Three-phase induction motors. Direction reversal by change of phase-sequence of connections.
- Demonstration of Components of LT switchgear.

SEMESTER-III

DETAILED CURRICULUM CONTENTS

Course Code: BSC202 **Course Name:** Physics-II

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To learn about the development of modern Physics and the theoretical formulation of quantum mechanics.
- To learn the applications of quantum mechanics in solving physical problems.
- To learn lights and waves and their mathematical equation.
- To learn about semiconductors.

Course Description:

This course will analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories

Course Contents:

<u>Unit-I</u>

Waves : Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator. Non-dispersive transverse and longitudinal waves**,** Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves

<u>Unit-II</u>

Light and Wave Optics: Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

<u>Unit-III</u>

Lasers : Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity. Introduction to Quantum Mechanics Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle.

<u>Unit-IV</u>

Solution of Wave Equation : Solution of stationary-state Schrodinger equation for one dimensional problems–particle in a box, particle in attractive delta-function potential, square-well potential, linear harmonic oscillator. Scattering from a potential barrier and tunneling; related examples like alpha decay, field-ionization and scanning tunneling microscope, tunneling in semiconductor structures. Three-dimensional problems: particle in three dimensional box and related examples.

Unit-V

Introduction to Solids and Semiconductors: Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands. Types of electronic materials: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p -n junction

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Get understanding of physics of light and wave optics.
- Understand the wave equation.
- Investigate the effectiveness of laser generation for the benefit of mankind.

Text/ Reference books:

- I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
- H. J. Pain, "The physics of vibrations and waves", Wiley, 2006. .
- E. Hecht, "Optics", Pearson Education, 2008.
- A. Ghatak, "Optics", McGraw Hill Education, 2012
- O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
- D. A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education

Group, Chicago, 1997.

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40**

Course Code: BSC201 **Course Name:** Mathematics-III

Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The main objective of this course is to provide students with the probabilistic and statistical analysis mostly used in varied applications in engineering and sciences and it provide the methods of organising and simplifying data so that their significance is comprehensible.

Course Description:

This course provides an introduction to probability and statistics with applications. Topics include: random variables, continuous and bivariate probability distributions, Bayesian inference, hypothesis testing, confidence intervals, curve fitting and regression.

Course Contents:

Unit 1: Basic Probability (12 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit 2: Continuous Probability Distributions (4 hours)

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Unit 3: Bivariate Distributions (4 hours)

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 4: Basic Statistics (8 hours)

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit 5: Applied Statistics (8 hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Unit 6: Small samples (4 hours)

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Course Learning Outcomes (CLOs):

CLO-1: Recognize basic probability theory and its application.

CLO-2: calculate Continuous Probability Distributions and their properties.

CLO-3: Calculate bivariate distributions and their properties with applications.

CLO-4: Basic concept of Statistics, Probability distribution and correlation.

CLO-5: Fitting the data and large sample testing.

CLO-6: Testing the hypothesis for Small samples

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers

(iii) S. Ross, "A First Course in Probability", Pearson Education India,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,

(ii) W. Feller, "An Introduction to Probability Theory and its Applications", Wiley,

Online links for study & reference materials:

https://nptel.ac.in/courses/111/105/111105041/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 04%
Assignment -2	- 04%
Assessment-3(Mid-Exam)	- 20%
Assignment-3	- 04%
Assignment-4	- 04%
Assignment-5	- 04%

Total Internal Assessment **- 40%**

Course Code: BSC109/202 **Course Name:** Biology (Biology for Engineers)
Course Credit: 3 **Total Contact Hour:** 33hr

Course Objective:

- ✓ To increase the understanding of living systems.
- ✓ To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.
- ✓ To understand the Hierarchy of life forms at phenomenological level.
- ✓ To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment.
- ✓ To learn the systems in relationship to the self and other organisms in the natural environment.
- ✓ To analyze biological processes at the reductionistic level Proteins- structure and function.
- ✓ To know and learn the fundamental principles of energy transactions.

Course Description:

This course explains the fundamental biological processes of metabolism, homeostasis, reproduction, development, and genetics, and the relationships between form and function of biological structures at the molecular, cellular, organismal and population levels of the biological hierarchy.

Module 1. *(2 hours)- Introduction*
Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. *(3 hours)- Classification*
Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure-prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. *E. coli, S. cerevisiae,* D. Melanogaster, C. elegance, A. Thaliana, M. musculus.

Module 3. *(4 hours)-Genetics*
Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of

genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. *(4 hours)-Biomolecules*
Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. *(4 Hours). Enzymes*
Purpose: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. *(4 hours)- Information Transfer*
Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. *(5 hours). Macromolecular analysis*
Purpose: How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. *(4 hours)- Metabolism*
Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO2 + H2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

Module 9. *(3 hours)- Microbiology*
Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Course Learning Outcomes (CLOs):

At the end of this course students will learn:

- The major types of molecules that make up living organisms and how these molecules enable life functions.
- The structures found in cells and the functions of those sub-cellular structures.

- The processes by which cells replicate to produce genetically identical, or genetically variable, daughter cells.
- The roles carbohydrates play in biological systems
- The structure and function of proteins
- Nucleic acids and the role they play in DNA and RNA
- Thermodynamics as applied to biological systems
- Identification and classification of microorganisms.

Text / References:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, "Microbiology", McGraw Hill Higher Education, 2005.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ESC201 **Course Name:** Basic Electronics Engineering

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand structure, working and application of diodes.
- To analyze and understand the Bipolar junction transistor and their application.
- To understand characteristics of FET and op-amp with application.
- To understand concepts of oscillator and digital electronics.

Course Description:

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the devices, instruments and sensors used in Engineering applications.

Course Contents:

Unit 1: Diodes and Applications :-Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications; Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications;

Unit 2: Transistor Characteristics :- Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Voltage Divider Bias Configuration; Field Effect Transistor (FET)– Construction, Characteristics of Junction FET, Depletion and Enhancement type Metal Oxide Semiconductor (MOS) FETs.

Unit 3: Transistor Amplifiers and Oscillators :- Classification, Small Signal Amplifiers – Basic Features, Common Emitter Amplifier, Coupling and Bypass Capacitors, AC Equivalent Circuit; Feedback Amplifiers – Principle, Advantages of Negative Feedback, Topologies, Current Series and Voltage Series Feedback Amplifiers; Oscillators – Classification, RC Phase Shift, Wien Bridge, High Frequency LC and Non-Sinusoidal type Oscillators;

Unit 4: Operational Amplifiers and Applications :- Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal OpAmp, Concept of Virtual Ground; , inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Unit 5: Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/ subtractor, multiplexers, de-multiplexers, flip-flops.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Know broadly the concepts and functionalities of the electronic devices, tools and instruments
- Understand use, general specifications and deployabilities of the electronic devices, and assemblies
- Confidence in handling and usage of electronic devices, tools and instruments in engineering applications instruments

Text books:

- Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.

Reference books:

- R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
- Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Online links for study & reference materials:

https://nptel.ac.in/courses/117/103/117103063/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: ESC201

Course Name: Engineering Mechanics

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

- To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies
- To learn the effect of friction on equilibrium.
- To learn kinematics, kinetics of particle and rigid body, related principles.
- To implement the above know how to solve practical problems.

Course Description:

This course is an introduction to learning and applying the principles required to solve engineering mechanics problems. Concepts will be applied in this course from previous courses you have taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving.

Course Contents:

Unit-I

Force Vectors: Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

Unit-II

Force System Resultant: Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application.

Unit-III

Oscillation and Resonance: Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum; Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance.

Unit-IV

Rigid Body: Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

Unit-V

Moment of Inertia: Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Analyze and solve the practical problems of statics and dynamics.
- Take up the subjects like TOM, SOM, Design of machine elements, DOS, TOS etc.

Text books:

- Hibbeler, R.C., "Engineering Mechanics: statics", 12th edition, and Prentice Hall
- Beer, F.P. and Johnston, E.R. (2007) “Vector Mechanics for Engineers (Statics)”, McGraw-Hill.

Referenc books:

- MK Harbola “Engineering Mechanics”, 2nd ed.
- MK Verma “Introduction to Mechanics”
- D Kleppner & R Kolenkow An Introduction to Mechanics, 2001
- JL Synge & BA Griffiths “Principles of Mechanics” TMH, 1999.
- JL Meriam “Engineering Mechanics – Dynamics”, 7th ed.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-ME201 **Course Name:** Thermodynamics

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To learn about work and heat interactions, and balance of energy between system and its surroundings.
- To learn about application of I and II law to various energy conversion devices
- To evaluate the changes in properties of substances in various processes
- To understand the difference between high grade and low grade energies and II law limitations on energy conversion

Course Description:

This course explains the detail of thermal concepts studied in physics at the school level. The course describes the fundamentals of analyzing any system and applying the various laws of thermodynamics in it. The course addresses about the energy conversion and the various energy interactions from low grade energy to high grade energy and vice versa along with their effects on the surrounding. The course also addresses the applications of various thermodynamic cycles used in the real world engineering applications like power plants and refrigeration plants.

Course Contents:

Unit-I

Fundamentals and Zeroth law of Thermodynamics: System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems

Unit-II

First law of Thermodynamics: First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Unit-III

Pure substance and Gas mixtures: Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier’s chart.

Unit-IV

Second law of Thermodynamics: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates.

Unit-V

Availability and Thermodynamic cycles: Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis. Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

Course Learning Outcomes(CLOs) :

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions

2. Students can evaluate changes in thermodynamic properties of substances

3. The students will be able to evaluate the performance of energy conversion devices

4. The students will be able to differentiate between high grade and low grade energies.

Text books:

1. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
2. Cengel Y.A. and Boles M. A., 2005, Thermodynamics: An engineering approach, McGraw-Hill Education.

Reference books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.

2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Online links for study & reference materials:

https://nptel.ac.in/courses/103/104/103104151/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER-IV

DETAILED CURRICULUM CONTENTS

Course Code: PCC ME202

Course Name: Applied Thermodynamics

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

- To learn about of First law for reacting systems and heating value of fuels
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychometric.
- To learn about gas dynamics of air flow and steam through nozzles
- To understand about reciprocating compressors with and without intercooling

Course Description:

Thermodynamics is a subject of fundamental interest to Mechanical engineers and therefore is always taught in the 3rd or 4th semester. Present course can be viewed as the next step, where the thermodynamic principles will be employed to discuss about different power producing & absorbing cycles. Properties of pure substance will be discussed, along with the thermodynamic property relations, thereby enabling the participants to estimate all relevant thermodynamic properties at any particular state point. Subsequently the gas & vapor power cycles will be analyzed, followed by the principles of cogeneration & combined cycles. Then the refrigeration cycles will be introduced, followed by a discussion on the selection of refrigerants. Subsequently the properties of gas mixtures and gas-vapor mixtures will be discussed, leading to psychrometry & psychrometric processes. The course will be completed with a brief introduction to the chemical equilibrium.

Course Contents:

Unit-I

Fuels and Air Standard Cycle : Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy. Air standard Otto Cycle, Diesel Cycle, Dual cycles, Air standard Brayton cycle.

Unit-II

Compressible Flow: Basicsof compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser

Unit-III

Steam Power Cycle: Rankine cycle with superheat, reheat and regeneration, Exergy analysis. Super-critical and ultra super-critical Rankine cycle.

Unit-IV

Reciprocating Compressor & Steam Turbine: Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

Unit-V

Properties of Air: Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Get a good understanding of various practical power cycles and heat pump cycles
- Identify and formulate power production based on the fundamentals laws of thermal engineering.
- Investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
- Communicate effectively the concepts of internal combustion engines and try to think beyond curriculum in alternative sources of energy.
- Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.

Text books:

- Y.A. Cengel & M.A. Boles, Thermodynamics: An Engineering Approach, 8th Ed., McGraw Hill Education (India) Pvt. Ltd., New Delhi,2016.
- R.E. Sonntag, C. Borgnakke & G.J. Van Wylen, Fundamentals of Thermodynamics, 6th Ed., John Wiley, 2003. 3. T.D. Eastop & A. .

Reference books:

- McConkey, Applied Thermodynamics, 5th Ed., Pearson Education Ltd., New Delhi, 2014.
- P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008
- P. W Gill, J. H. Smith., E. J. Ziurys; Fundamentals of Combustion Engines; Oxford & IBH Publishing Co. Pvt. Ltd.; 4th revised Ed.;1967
- G. V. Wylen; R. Sonntag, C. Borgnakke; Fundamentals of Classical Thermodynamics; John Wiley & Sons, 4th Ed.; 1996. 5.. 61996.
- G. Rogers, Y. Mayhew; Engineering Thermodynamics-Work and Heat Transfer; Pearson Education Ltd., 7th Ed.; 2012

Online links for study & reference materials:

http://onlinecourses.nptel.ac.in/noc19_me57/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-ME203

Course Name: Fluid Mechanics & Fluid Machines

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis.
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.
-

Course Description:

The course describes the fundamentals of various fluid properties and the behavior of fluid. The course describes about the various concepts of fluid statics, fluid kinematics, fluid dynamics and boundary layer. The course addresses the applications of various theorems used in fluid mechanics and about the non-dimensional analysis of fluid systems. The course also describes the concepts of various hydraulic turbines and pumps along with their related phenomena used in the real world applications.

Course Contents:

UNIT 1: Fluid Properties and Fluid Kinematics

Definition of fluid, Newton's law of viscosity, Units and Dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, fluid acceleration concept, Potential Function, Stream Function, Circulation.

UNIT 2: Fluid Dynamics

Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications. Couette and Poisuielle flow, laminar flow through circular Pipes—Hagen Poiseuille equation, Darcy Weisbach equation, friction factor, Moody's diagram.

UNIT 3: Boundary Layer and Non-Dimensional Analysis

Concept of boundary layer – measures of boundary layer thickness, Von Karmann momentum integral equation, Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude, Dimensionless Numbers– Model analysis.

UNIT 4: Hydraulic Pumps

Euler's equation – theory of Rotor dynamic machines, various efficiencies, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitations in pumps, Reciprocating pump – working principle.

UNIT 5: Hydraulic Turbines

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Course Learning Outcomes(CLOs) :

1. Upon completion of this course, students will be able to mathematically analyze simple flow situations.
2. They will be able to apply non-dimensional analysis for simple real flow problems.
3. They will be able to evaluate the performance of pumps and turbines.

Text books:

1. Fluid Mechanics and Hydraulic Machines, Dr. R.K. Bansal, Laxmi Publications (P) Ltd, 2010.
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.

Reference books:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.

2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill.

3. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/105/112105183/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-ME204

Course Name: Strength of Materials

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading..
- To learn kinematics, kinetics of particle and rigid body, related principles.
- To implement the above know how to solve practical problems.

Course Description:

This course is an introduction to learning and applying the principles required to solve strength of materials problems. Concepts will be applied in this course from previous courses you have taken in basic maths and physics. The course addresses the analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving.

Course Contents:

<u>Unit-I</u>

Deformation in solids-: Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains

<u>Unit-II</u>

Compound Stress: Concept of complex stress system, Uniaxial, Biaxial and Biaxial along with shear stress system. Principal stresses and principal planes- Mohr's circle. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

<u>Unit-III</u>

Shear Force and Bending moment of a Beam: Beams and types transverse loading on beams- shear force and bending moment diagrams Types of beam supports, simply supported and over-hanging beams, cantilevers.

<u>Unit-IV</u>

Theory of Simple Bending and Slope and Deflection: Theory of bending of beams, Derivation of bending formula , Concept of Flithed Beam . bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems

Unit-V

Torsion: Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text books:

- Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001
- R. Subramanian, Strength of Materials, Oxford University Press, 2007

Reference books:

- R. Subramanian, Strength of Materials, Oxford University Press, 2007
- Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.
- Dr S S Rattan "Strength of Materials" Tata McGraw Hill

Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGrawHill Publishing Co. Ltd., New Delhi 2005.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCCME 205 **Course Name:** Material Engineering

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Description:

This course is designed as a first introduction to microstructure and mechanical properties of engineering materials for undergraduate engineering students. The focus will be on clear presentation of basic fundamentals of structure and defects of crystalline materials. This will then be used to understand the transformations, heat treatments and mechanical behavior of structural materials. The course will also include several classroom and laboratory demonstrations.

Course Contents:

Unit-I

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Unit-II

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit-III

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT)

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Unit-IV

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

Unit-V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Student will be able to identify crystal structures for various materials and understand the defects in such structures
- Understand how to tailor material properties of ferrous and non-ferrous alloys
- How to quantify mechanical integrity and failure in materials

Text books:

- W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition,

Wiley India.

- Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of

India Private Limited, 4th Indian Reprint, 2002.

Reference books:

- V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
- U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Online links for study & reference materials:

https://nptel.ac.in/courses/113/102/113102080/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PCC-ME 206** **Course Name:** Instrumentation and control

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

Course Description:

This course is an introduction to learning and applying the principles required to solve Instrumentation problems. Concepts will be applied in this course from previous courses you have taken in basic math's and physics.

Course Contents:

Unit I

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements;

UNIT II

Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram;

UNIT III

control method – P, PI, PID, when to choose what, tuning of controllers; transfer function and system response, frequency response;

UNIT IV

Nyquist diagrams and their use. Practical group based project utilizing above concepts.

Course Learning Outcomes(CLOs) :

Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Text books:

- Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200 2
- Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard

Reference books:

- Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007

- Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER-V

DETAILED CURRICULUM CONTENTS

Course Code: PCC AE 301 **Course Name:** Automotive Transmission Systems

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

1. To familiarize with the terminology associated with Automotive transmission.
2. To learn about the design procedures for automotive power transmission components
3. To understand the working principles of various types of transmission

Course Description:
This course is an introduction to learning of transmission systems used in automobile. Concepts will be applied in this course from previous courses you have taken, like that of machine design, thermodynamics and material science, along with engineering design.

Course Contents:

UNIT 1

Transmission requirements:

Requirements of transmission system, general arrangements for power transmission for front engine, rear engine vehicle, four wheel drive vehicle, dead axle and axle less transmission.

Clutch :

Purpose, Type of clutch , One way clutch etc. Diaphragm clutch , Faults & remedies , Power clutch , dual clutch system . Selection criterion area of gear ratio, sliding mash.Single plate, multi plate clutch, centrifugal clutch, electromagnetic clutch, constructional
details, torque capacity and clutch friction materials.

UNIT II

Gear Box :Purpose constant mash & synchromesh gear boxes , Gear selection and selector and
shifting mechanism. Layout of a 5 forward and 1 reverse gear box , G.B. Lubrication , Transfer
Gear Box , Four Wheel drive ,Requirements of gear box, sliding mesh gear box, constant mesh gear box, epicyclic gear box, velocity ratio and gear ratio for vehicle, performance characteristics indifferent speed , overdrive.

UNIT III

Propeller Shafts & Universal Joints :

Torque tube and Hotchkiss drive Hooks type.Universal joints , shaft whirling , C.V. Joints, Divided propeller shaft, rubber universal coupling, slip joints. Fluid Coupling : Principle of operation, constructional details, torque capacity and performance curve.

Torque converter :Principle of operation, constructional details, torque capacity and performance curve..

UNIT IV

Final Drive and Rear axle :

Purpose of differential , Construction and working , non slip differential chain sprocket final drive ,cone pulley. Live and Dead axle , Fully floating ,Wheels &Tyre :Type of wheels , Construction , wired wheels , tyre , construction types, Radial, bias &belted bias,comparison slip angle , under and over steering, thread pattern, tyre retreading cold & hot , tyrespecification , tubeless tyre.Hydrostaticdrive:Various types of hydrostatic system, working principle of hydrostatic system, advantage andlimitations, Jenny hydrostatic drive,

UNIT V

Suspension :

Purpose , front and rear suspension , Two and four wheel independent suspension, suspension system components , Leaf spring , coil springs , dampers , torsion, bar , Mac pherson strut
,Stabilizer bars, Arms, etc. Air suspension systems , Types of front & rear suspension.Steering System : Types of steering system , Ackermann principles, Davis steering gear, systemcomponents , steering gear boxes, rack and pinion steering gear, type of steering linkages ,Power steering , wheel geometry, caster , camber, toe in , toe out etc. Wheel alignment andwheel balancing.

UNIT VI

Brakes ;

Types of Brakes , Mechanical hydraulic , Air brakes , Disc & drum brakes , self energizing brakes, Engine Brakes , Brake system components, Valve calipers , shoes.AutomaticTransmission:Need for automatic Transmission, Chevrolet turbo glide transmission system, torque flite,Automatic transmission fluid, effect of automatic transmission on vehicle performance and fueleconomy.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Design automotive transmission systems.

Text Books

1. Power Transmission , Anil Chikara, Satya Publication.

Reference books:

2. Automotive Mechanics , William . H. Couse , McGraw-Hill Publication
3. Automobile Engineering , Kripal Singh, Standard Publication.
4. Automobile Engineering , K.M. Gupta , Umesh Publication

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-ME 302 **Course Name:** Solid Mechanics

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Description:

This course is an introduction to learning and applying the principles required to solve Mechanics of solid problems. Concepts will be applied in this course from previous courses you have taken in basic math's and physics.

Course Contents:

UNIT I

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility,

UNIT II

Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions Constitutive equations:

UNIT III

Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition. Plane stress and plane strain problems,

UNIT IV

introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems. Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems,

UNIT V

thermo-elasticity, 2-d contact problems. Solutions using potentials. Energy methods. Introduction to plasticity.

Course Learning Outcomes (CLOs):

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

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Text books:

G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.

Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965

Reference books:

 Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course code : PCC-ME 303 **Course Name:** Manufacturing Processes
Course Credits : 3 **Total Contact Hour:** 40 hr

Course Objectives:

- To understand and develop an appreciation of the processes in correlation with material properties
- To learn to change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods
- To understand the concept and basic mechanics of metal cutting, milling, drilling and grinding and allied

Course description:

This course is an introduction to learning and understanding different manufacturing principles which are required to solve the problems of industrial base. This course gives the insight view how shape and size correlated with grain structure and mechanical property. It explains how the properties can be altered through conventional and non conventional manufacturing processes.

Course Contents:

Unit-1

Casting: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Unit-2

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Unit-3

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit-4

Additive manufacturing: Rapid prototyping and rapid tooling Joining/fastening processes: Physics of welding, brazing and soldering;design considerations in welding,Solid and liquid state joining processes;Adhesive bonding.

Unit-5

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Course Learning Outcomes (CLOs):

Upon completion of this course the student will be able to:

- Select appropriate processes for manufacturing industrial products
- Identify routings of the operations and equipment involved in changing raw materials into useable products
- Propose the integration of appropriate processes in a proper sequence to manufacture an economical product

Text Books:

- Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
- Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

Reference books:

- Degarmo, Black &Kohser, Materials and Processes in Manufacturing

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107144/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-ME304 **Course Name:** Kinematics and Theory of Machines

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
- To be able to design some linkage mechanisms and cam systems to generate specified output motion.
- To understand the kinematics of gear trains.

Course Description:

This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms, open and closed-chain planar robots, and geared transmission. The discussion will start with an introduction to the subject matter and nomenclature, and will cover direct and inverse kinematics, velocity and acceleration analysis, kinematic path generation for robots, singularities in kinematic chains, principle of virtual work and force analysis, and kinematic analysis of gear transmission.The course will demonstrate various concepts by working out problems relevant to real life applications of mechanisms. The course is expected to help students in their basic understanding and use of kinematic analysis.

Course Contents:

Unit-I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chainsLimit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

Unit-II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesisthree position graphical synthesis for motion and path generation.

Unit-III

Classification of cams and followers- Terminology and definitions- Displacement diagramsUniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

Unit-IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit-V

Surface contacts- sliding and rolling friction- friction drives- bearings and lubricationfriction clutches- belt and rope drives- friction in brakes

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

Text books:

- Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
- CleghornW.L. Mechanisms of Machines, Oxford University Press, 2005.

Reference books:

- Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
- Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated EastWestPvt. Ltd, New Delhi, 1988.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/104/112104121/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40**

Course Code: PCCME304

Course Name: Kinematics & Theory of Machines

Course Credit: 4

Total Contact Hour: 40hr

Course Objective:

- To understand the kinematics and rigid- body dynamics of kinematically driven machine components
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
- To be able to design some linkage mechanisms and cam systems to generate specified output motion
- To understand the kinematics of gear trains

Course Description:

This course is an introduction to learning and applying the principles required to solve engineering mechanics of machine and mechanism problems. Concepts will be applied in this course from previous courses you have taken in basic math and physics. The course addresses the modeling and analysis of mechanism of machines problems with an emphasis on real world engineering applications and problem solving.

Course Contents:

Unit-I

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chainsLimit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

Unit-II

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesisthree position graphical synthesis for motion and path generation/

Unit-III

Classification of cams and followers- Terminology and definitions- Displacement diagramsUniform velocity, parabolic,simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

Unit-IV

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

Unit-V

Surface contacts- sliding and rolling friction- friction drives- bearings and lubricationfriction clutches-belt and rope drives- friction in brakes

Course Learning Outcomes(CLOs) :

- After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

Text books:

- Thomas Bevan, Theory of Machines, 3 edition, CBS Publishers & Distributors, 2005.
- CleghornW.L. , Mechanisms of Machines, Oxford University Press, 2005.

Reference books:

- Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
- Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106270/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER-VI

DETAILED CURRICULUM CONTENTS

Course Code: **Course Name:** Automotive Chassis and Auto System Design
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

1. To familiarize with the terminology associated with Chassis.
2. To learn about the design procedures for automotive mechanics
3. To understand the design requirements od chassis.
4. To understand the system designing of automotive systems.

Course Description:
This course is an introduction to learning the design of chassis used in automobile. Concepts will be applied in this course from previous courses you have taken.

Course Contents:

UNIT 1

Introduction of Auto System Design:

Aspects of Auto Design, Design Procedure, Principle of Design, Classification of design, Basic
requirements of design, Quality of Design Engineer. Automotive chassis and chassis frame:general considerations related to chassis layout, power plant location, weight distribution,stability, types of frame, materials, calculation of stresses on sections construction details, loadingpoints, testing of frames in bending and torsion.

UNIT2

Design of IC Engine Parts:

General considerations of Engine Design, Principle of Similitude, and Design of Engine
Components like: Piston, Cylinder, Connecting rod, Crank shaft, Valves.

UNIT 3

Design of Clutch:

Types of friction clutches, requirements of clutches, general design consideration, design the
equation for power transmitted through single plate and multi plate clutch for Uniform wear and uniform pressure, design for dimensions of clutch, equation for centrifugal clutch.

UNIT 4

Design of Brake:

General design considerations, braking efficiency, braking torque on the shoe, effect ofexpanding mechanism of shoes on braking torque, braking of vehicle for two wheel drive and fourwheel drive, braking of vehicle for curved path calculation of mean lining pressure and heat
generation during brake operation.

UNIT 5

Design of Suspension System:

Function suspension system in automobile, design of helical coil spring, leaf spring, materials for
spring, standard sizes of automobile suspension spring. Propeller Shaft: Design of Propeller
shaft, Design of universal Joint.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Explain the overall chassis system
- Design the overall chassis and system of an automobile.

Text Books

1. Auto Design, Gupta R.B., Satya Publication.

Reference books:

1. Element of Design ,Bhandari V.B., Tata McGraw-Hill publication
2. Machine Design, Khurmi R.S.., S Chand Publication , New Delhi.
3. Machine Design, Sharma and Agrawal, S.K. Kataria.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-AE 308 **Course Name: Automotive Control Engineering**
Course Credit: 3 **Total Contact Hour:** 40hr

UNIT 1
Introduction:
Concepts of automatic controls, open and closed loop systems, concept of feedback control. Requirements of an ideal control system. Differential equations for mechanical systems,transnational and rotational systems, Electrical systems such as servos, D.C. motors, A.C.Servomotors, Hydraulic systems, hydraulic servos meters, thermal systems, integrating devices, temperature control systems, error detection.

UNIT 2
Systems Response:
First and second order system response to step, ramp and sinusoidal inputs. Concept of time constant and its importance in speed response. Response of a system to an external disturbance. Mathematical concept of stability. Routh's Hurwitz criterion.

UNIT3
Block diagrams:
Signal Flow Graphs and Transfer Function: Definition of transfer function, block representation ofsystem elements. Reduction of block diagrams and signal flow paths, Basic properties, signal flow graphs, gain formula to block diagrams.

UNIT 4
Frequency Response:
Polar and rectangular plots for frequency response. Experimental determination of frequency response. System analysis using Nyquist diagrams, relative stability, concept of margin gain and phase margin. M & N cycles.

UNIT 5
Systems Analysis:
Systems Analysis using logarithmic Plots: Bode attenuation diagrams, Stability analysis using Bode diagrams, Simplifies Bode diagrams; Systems Analysis using Root Locus Plots: Definitionsof root locus plots and root loci. Graphical relationship, setting systems gain. System Compensation

List of Recommended Books

1. Control System Engineering , Nagrath & Gopal , 4th Edition New age.
2. Modern Control Engineering ,. Ogata K, PHI Publication.
3. Automatic Control System, Kuo B.C., Willey India.
4. Modern Control Engineering , D.Roy Chaudhary, PHI Publication

Course code: PCC-ME 307 **Course Name:** Manufacturing Technology
Course credits :4 **Total contact hours :** 40 hrs

Course Objectives:

- To provide knowledge on machines and related tools for manufacturing various components.
- To understand the relationship between process and system in manufacturing domain.
- To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course description:

This course gives the insight view of design for manufacturing and design for assembly. This course introduces the concept and solution to problems based on industries. This course describes things from measuring instruments to manufacturing of tools, jigs and fixtures needed in traditional and non-traditional machining. Also it describes about simplex methods and transportation problems used in industries.

Course Contents:

Unit 1

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

Unit -2

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality.

Unit-3

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

Unit-4

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling;

Unit-5

Production planning& control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.

Course Learning Outcomes (CLOs):

Upon completion of this course student will be able to

- Do the tooling needed for manufacturing, the dimensional accuracy and tolerances of products.
- To do assembly of different components and the application of optimization methods in manufacturing.

Text Books:

- Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
- Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.

Reference books:

- Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

Online links for study and reference materials:

https://nptel.ac.in/courses/112/105/112105127/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **Course Name:** Auto Emission and IC Engine Tribology

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

1. To familiarize with the terminology associated with Emissions.
2. To learn about the design procedures for IC Engine and its Tribology.
3. To understand the emission requirements and government norms
4. To understand the alternate fuels
5. To design of IC Engine according to alternate fuels and its combustion characteristics.

Course Description:
This course is an introduction to learning of internal combustion engines, and the use of alternate fuels in these engines. Concepts will be applied in this course from previous courses you have taken like thermal engineering, IC Engine, etc.

Course Contents:

UNIT 1

Engine emissions and air pollution:

Constituents of engine exhaust responsible for air pollution and their effect on human health,plant ecology, ozone layer depletion and global warming, Photochemical smog, greenhouse gases. Kyoto protocol and carbon trading. Formation of Pollutants: Combustion generated andother pollutants, general mechanisms and kinetics of formation of carbon-monoxide, unburnthydrocarbon, oxides of nitrogen and particulate matter due to combustion, effect of air-fuel ratio
on emissions, extended Zeldovitch mechanism for formation of NOx, soot and smoke formation.
NOx particulate trade-off.

UNIT 2

Emissions from Spark ignition engines:

Types of emission form spark ignition engines, importance of mixture formation, lean and richmixture, study of various mechanism of formation of unburnt hydrocarbon, effect of variousdesign and operating variables on formation of CO, UBHC and NOx. Discussion on differenttechnologies for reducing engine out emissions from a spark ignition engine, gasoline port injection and gasoline direct injection. Evaporative emissions and their control.

UNIT 3

Emissions from Compression Ignition engines:

Types of emissions from compression ignition engine, effect of various design and operatingvariables on formation of NOx, smoke and particulate matter. Discussion of various technologies for reducing engine out emissions from a compression ignition engine such as turbo charging,inter-cooling, fuel injection pressure, injection timing retard, exhaust gas recirculation (EGR) etc.

UNIT 4

Introduction:

Estimation of petroleum reserves, need for alternative fuels, availability and properties of alternative fuels. Merits and demerits of alternative fuels. Alcohols: properties of alcohol as SI engine fuel, ethanol and methanol, ethanol- gasoline blends, methanol -gasoline blend, combustion characteristics in the fuel engines, performance and emission characteristics.

UNIT 5

Compressed natural gas, LPG and biogas,

availability of CNG properties, modification required to use in engine- performance and emission characteristics of CNG vehicles SI and CI Engines. Use of LPG in SI engine: performance and emission for LPG. Biogas generation, properties, performance and emission characteristics, storage, handling and safety aspects,

UNIT 6

Bio-diesel:

Different sources of vegetable oils use of straight vegetable oils in engine, Trans-etherification, bio-diesel, bio-diesel properties and standards, biodiesel blends. Engine performance and emission characteristics with use of biodiesel and its blends, worldwide trends in use of bio diesel.

Hydrogen : hydrogen as SI engine fuel, properties combustion characteristics, port injection, timed injection, direct injection of hydrogen in engines, backfire arrest, performance and emissioncharacteristics, production, storage and handling, safety aspects.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Prove himself an asset to the environment
- Lower down emission created by an automobile.
- Follow the rules sit up by Govt of India to resuce pollution
- Follow the alternate fuels, which pose less harm to the environment

Text Books

1. Automobiles Pollution , Paul Degobert , SAE International.
2. Engine Emission , Pundhir B.P. , Narosa Publications

Reference books:

1. Alternative Fuels Guide Book , Becfold L., SAE International.
2. Energy today and tomorrow , Maheswar Dayal , I& B publication India
3. Fundamental of TribologyBasu , S.K. , PHI
4. Lubrication of Bearing , Redzimoyskay, SAE International.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER-VII

DETAILED CURRICULUM CONTENTS

PCC-AE 401 Vehicle Aerodynamics and Vehicle Body Engineering 3L:0T:0P 4 Credits

UNIT 1
Introduction:
Importance of vehicle design in modern automobile industries. Criteria for vehicle body design, Types of frame, construction details, loading points, testing of frames in bending and torsion. Different types of metal joining process used in vehicle body construction.

UNIT 2
Car Body Details:
Types : Saloon , Convertibles, Limousine, Sedan , Hatchback , Racing and sports car. Car visibility- driver's visibility, regulation , visibility test, method of improving visibility and space in cars , Safety in design of car , Car body construction. Bus Body Details : Types: Mini bus, single Decker bus, Double Decker bus, articulated bus , Bus body layout , floor height, engine location, entrance and exit , seat layout , seat dimension. Construction details-frame construction , double skin construction, types of metal section used , conventional and integral type construction. Commercial vehicle Details: Types of body : Flat platform , drop side , fixed side , tipper body , tanker body , light commercial vehicle body types – dimension of driver seat in relation to control- Driver cabin design.

UNIT –3
Vehicle aerodynamics:
Introduction , Aerodynamics forces , Drag, Drag reduction , stability and cross winds various body
optimization technique for minimum drag, Wind tunnel testing, Scale model testing,

UNIT 4
Body Load:
Symmetric & asymmetrical vertical loads in car. different load case in vehicle- Bending case , Torsion case, Combined bending and torsion , lateral loading Idealized structure – Structural surface –shear panel method. Body material trim and mechanism: Steel sheet , timber , plastic , GRP, FRP , Properties of materials- corrosion – anticorrosion method. Selection of paints and various processes. Body trimming process- dent beating tools, riveting method, welding method. Body mechanism- door lock mechanism , window glass winding mechanism.

UNIT 5
Safety in vehicle design:
Basics of impacts protection, design for crashworthiness , front impact and side impact analysis, bumper system , energy absorbent forms. Indian Motor acts and its application- The motors vehicle acts 1988, Driving license , Registration of vehicles, Rules of the road, Motor Insurance.

List of Recommended Books
1. Vehicle Body Engineering , Powlosky J, Business Books.
2. Body Construction & Design , Giles J.C. , Liiffe Books Butterworth.
3. Vehicle Body Layout and Analysis , John Fenton , M. Engineering Ltd.
4. Vehicle Body Building and Drawing , Heinemann, Education Books Ltd. London

PEC-AEL 402 Microprocessor application in Automobile 3L:0T:0P 4 Credits

UNIT 1

Architecture:

General 8 bit microprocessor and its architecture 8085, Z-80 and MC 6800 MPU and its pin function: Architecture-Function of different sections.

UNIT 2

Instruction Set:

Instruction format-addressing modes-instruction set of 8085 MPU TSTATE- Machine cycle and instruction cycles-Timing diagrams-Different machine cycles- Fetch and execute operations estimation of execution times.

UNIT 3

Assembly Language Programming:

Construct of the language programming-Assembly format of 8085-Assembly Directive-Multiple precision addition and subtraction-BCD to Binary and Binary to BCD, Multiplication, Division, Code conversion using look up tables- Stack and subroutines.

UNIT 4

Data Transfer Schemes:

Interrupt structure-Programmed I/O-Interrupt driven I/O, DMASerial I/O. Types of interfacing devices: Input/Output ports 8212, 8255, 8251, 8279. Octal latches and tristate buffers-A/D and D/A converters-Switches, LED's ROM and RAM interfacing.

UNIT 5

Applications:

Data acquisitions- Temperature control-Stepper motor control-Automotive applications Engine
control, Suspension system control, Driver information.

List of Recommended Books

1. Integrated Electronics, Milman and Holkias Tata Mc Graw-Hill Publication.
2. Microprocessor Architecture, Ramesh Goankar, Willey India.
3. Digital Principle and Application, Malvino and Leach, Tata McGraw-Hill Publication.
4. Principle Of Electronics, Mehta V.K. , S.Chand publication.

PCC-AE403 BODY ENGINEERING LAB 0L:0T:1P 1 Credit

1. Perform the visibility test on the vehicle.
2. Study of different types of tool used in body shop
3. Perform the various joining processes (welding, riveting) in the body material.
4. Assembling and dismantling of various body mechanisms like door lock mechanism, window winding machine mechanism, passenger seat mechanism.
5. Perform the dent beating process on the metal sheet.
6. Study and perform the various painting process on the car.
7. Make the different scale model (Bus body model, TATA 407 model).
8. Study of Modern vehicle design.
9. Study of vehicle crash analysis.

PROJ ME 403 (Project III)

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester.

SEMESTER-VIII

DETAILED CURRICULUM CONTENTS

PROJ ME 404 (Project IV)

It is intended to finish the project work started in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

DETAILED ELECTIVE COURSE CONTENTS

Course Code: **PEC-MEL 321** **Course Name:** Internal Combustion Engine

Course Credit: 4 Total Contact Hour: 40hr

Course Objective:

1. To familiarize with the terminology associated with IC engines.
2. To understand the basics of IC engines.
3. To understand combustion, and various parameters and variables affecting it in various types of IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Description:

This course is an introduction to learning of internal combustion engines. Concepts will be applied in this course from previous courses you have taken.

Course Contents: Review of ideal cycles; Details of fuel-air cycles. Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion. Fuel supply systems in SI and CI engines, Carburettors, Port fuel injection, Direct injection and Common rail injection. Ignition system, Lubrication system and Cooling system. Testing of IC engines. Engine emissions and control. Advanced IC Engine concepts.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Have good idea of the basics of IC engines
- Show different parameters that influence the operational characteristics of IC Engines

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.

2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.

3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989

Reference books:

1. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.

2. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL323 Course **Name:** Microprocessor in Automation

Course Credit: 4 Total Contact **Hour:** 40hr

Course Objective:

- The study course has been composed for any student who has elementary knowledge in the field of engineering and programming and wish to gain basic practical skills of utilization of microcontrollers.
- The study course is based on practical studies and assumes active individual training of the students in the laboratory or at home.
- Development of a complete microcontroller-based control system with sensors is planned within the scope of the study course.

Course Description:

To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller.

Course Contents:

Unit-I

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

Unit-II

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Unit-III

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

Unit-IV

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED

display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251),

Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features,

Unit-V

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, ZTransform, Digital

Filters, Implementation of Digital Algorithm

Course Learning Outcomes (CLOs):

- Students who have done this course will have a good idea of the use of microprocessers for automation.

Text books:

- Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited.
- Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
- Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall.

Reference:

- Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
- Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.

Online links for study & reference materials:

- https://nptel.ac.in/courses/108/105/108105102/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL 322 **Course Name:** Composite Materials

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- To understand the mechanical behavior of composite materials.
- To get an overview of the methods of manufacturing composite materials.

Course Description:

This course enables the students to know and understand the mechanical behavior of composite materials.

Course Contents:

Unit-I

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke;s law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Unit-II

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

Unit-III

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply

laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses,

maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's

criterion for anisotropic materials, TsaiHill's criterion for composites, prediction of laminate failure, thermal

analysis of composite laminates

Unit-IV

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Course Learning Outcomes (CLOs):

Upon completion of this course, the students will have an overview of the mechanical behaviour and application of composite materials

Text books:

- Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
- Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Reference books:

- F. L. Matthews, Rees D. Rawlings, Composite Materials: Engineering and Science Woodhead Publishing, 1999.
- Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 1997

Online links for study & reference materials:

- https://nptel.ac.in/courses/112/104/112104221/
- https://nptel.ac.in/courses/112/104/112104229/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC-MEL 325

Course Name: Computer Aided Design

Course Credit: 3

Total Contact **Hour:** 40hr

Course Objective:

Student will be able to understand:

- The fundamental principles of hardware and software requirements in CAD.
- Able to design and draft simple as well as complex machine parts by using CAD software (through wireframe and surface modelling).

Course Description:

The course is designed to teach basic concepts of CAD, modelling, and finite element methods.

Course Contents:

Unit-I

Introduction of CAD: Introduction, Reasons for implementing a CAD system, Computer Aided Process

application, conventional design vs CAD. Computer graphics: Graphics input devices-cursor control devices,

digitizers, scanners and touch panels. Graphics display devices: CRT, Color CRT monitors, DVST, Flat

panel display, graphics output devices.

Unit-II

Line Drawing algorithms: Bresenham‘s line drawing and Mid-Point Circle algorithms. Geometric

Modelling of Curves Types of mathematical representation of curves, wire frame models, wireframe entities,

and parametric representation of synthetic curves- her mite cubic splines, Bezier curves, B-splines rational curves.

Unit-III

Geometric Modelling: Introduction to Geometric Modelling of Surfaces and Solids Surface entities utilized in CAD. Solid modelling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG). Graphics Standards: PHIGS, IGES, PDES. Standards in CAD.

Unit-IV

Transformation: Introduction of Geometric transformations, Transformation of Geometric Models,

Translation, Scaling, Reflection, Rotation, Homogeneous Representation, Concatenated Transformation.

Unit-V

Fundamentals of Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two-Dimensional bar & beam element analysis.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to:

- Use computers in Product Design and Development Process.
- Understand the prevalent display technologies.
- Understand the modelling of CAD geometric elements.
- Use CAD software like AutoCAD and CREO for modelling mechanical components.
- Design and analysis the spring element with the help of Finite Element Methods.

Text books:

- Ibrahim Zeid, —Mastering CAD CAM‖, Tata McGraw Hill Publishing Co. 2007.
- C. McMohan and J. Browne, —CAD/CAM Principles‖, II edition, Pearson Education, 1999.

Reference books:

- W. M. Neumann and R.F. Sproul, —Principles of Computer Graphics‖, McGraw Hill, 1989.
- D. Hearn and M.P Baker, —Computer Graphics‖, Prentice Hall Inc., 1992.

Online links for study & reference materials:

- https://nptel.ac.in/courses/112/102/112102102/
- https://nptel.ac.in/courses/112/102/112102101/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PCC ME 421 Course **Name:** Refrigeration and Air Conditioning

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To familiarize with the terminology associated with refrigeration systems and air conditioning.
- To understand basic refrigeration processes.
- To understand about the properties of dry and wet air and the principles of psychometric.
- To understand the basics of psychrometry and practice of applied psychrometrics

Course Description:

This Course provides a simple understanding of Refrigeration and Air-conditioning fundamentals. Ideally suited to those with a little or no knowledge of the subject. The course consists of different refrigeration cycles and understanding of psychrometry and psychrometric processes used for the purpose of air-conditioning. Further, the comfort air-conditioning and indoor environment health are also addressed in this course.

Course Contents:

Unit-I

Vapour Compression System: Classification of refrigeration systems. Advanced vapour compression cycles

Unit-II

Refrigerant: Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - System components.

Unit-III

Vapour Absorption System: Advanced sorption refrigeration systems and their components. Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system.

Unit-IV

Refrigeration Equipment and Application: Compressors, Condensers, Expansion devices and Evaporators -Performance matching of components of refrigeration systems.– Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

Unit-V

Psychomerty and Air Conditioning: Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Design different refrigeration as well as air conditioning processes and components
- Illustrate the fundamental principles and applications of refrigeration and air conditioning system
- Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems CO3 - CO4 - Present the properties, applications and environmental issues of different refrigerants.
- Calculate cooling load for air conditioning systems.

Text books:

 Y Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.

 Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000. .

Reference books:

 Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill,

1986.

 Manohar Prasad ,Refrigeration & Air-conditioning, , New Age International, 2nd Edition,2003

 Ananthanarayanan, Refrigeration and Air conditioning, Tata McGraw Hill

Online links for study & reference materials:

http://onlinecourses.nptel.ac.in/noc19_me58/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PEC-MEL 422** **Course Name:** Finite Element Analysis

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To illustrate the principle of mathematical modeling of engineering problems.
- To introduce the basics and application of Finite Element Method

Course Description:

Development of approach for solving problems using FEA Tools, understanding Industrial FEA requirements, Understanding the benefits and limitations of FEA and applying them for efficient Product Design

Course Contents:

Unit-I

Historical Background, Mathematical modeling of field problems in engineering, governing equations,

discrete and continuous models, boundary and initial value problems, Weighted Residual Methods,

Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element

Method.

Unit II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order bea equation, transverse

deflections and natural frequencies.

Unit III

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape

functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular

shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and

thermal loads, plate and shell elements.

Unit IV

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software**.**

Course Learning Outcomes (CLOs):

- Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text books:

- Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
- Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
- Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.
- Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Reference books:

- Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009.
- J. N. Reddy, " An Introduction to Finite Element Methods", 2e, McGraw Hill, 2009

Online links for study & reference materials:

- https://nptel.ac.in/courses/112/104/112104193/
- https://nptel.ac.in/courses/112/104/112104205/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PEC-MEL 423** **Course Name:** Power Plant Engineering

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

To provide an overview of power plants and the associated energy conversion issues.

Course Description:

The course describes the fundamentals of various power plants. The course describes the various thermodynamic cycles used in thermal, gas, nuclear and hydroelectric power plants along with their classification. The course addresses about the various integral parts of different power plants (conventional and non-conventional). The course also addresses the various economic and environmental aspects related to power plants.

Course Contents:

UNIT 1:

Thermal power plants: Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

UNIT 2:

Gas turbine and combined cycle power plants: Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT 3:

Nuclear power plants: Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT 4:

Hydroelectric power plants: Classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

UNIT 5:

Energy, economic and environmental issues: Power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Learning Outcomes(CLOs) :

Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

Reference books:

1. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107291/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL 424 **Course Name:** Gas Dynamic & Jet Propulsion

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

1. To understand the features of compressible isentropic flows and irreversibilities like shocks.

2. To provide a basic knowledge of jet and rocket propulsion technologies.

Course Description:

The course describes the fundamentals of compressible flow and jet Propulsion. The course addresses about the isentropic and non-isentropic flows compressible flow problems. The course also describes about the various types of nozzles, diffusers and shock wave relations. The course also addresses the concepts and applications of various jet Propulsion system including gas turbine engines and rocket engines.

Course Contents:

UNIT 1:

Compressible flow: Definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow.

UNIT 2:

Isentropic flow: Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT 3:

Non-isentropic flow: Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT 4:

Jet propulsion: Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT 5:

Rocket engines: Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

Course Learning Outcomes(CLOs) :

Upon completion of this course, the students will be able to apply gas dynamics principles to jet and space propulsion systems.

Text books:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.

2. H.S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing, 2004.

Reference books:

1. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.

2. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.

3. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Online links for study & reference materials:

https://nptel.ac.in/courses/101/104/101104019/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course code : PEC-MEL 425 **Course Name :** Process Planning and Cost Estimation
Course credits : 3 **Total contact hours :** 40 hrs

Course Objectives:

- To introduce process planning concepts to make cost estimation for various products
- To understand different methods of cost estimation in different manufacturing shops
- To enable them to comprehend the fundamental of contract administration, costing and budgeting
- Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course description:

This course describes the basic principle features of process planning. It introduces the concept of various activites needed for improvement in quality standards. This course demonstrates the skills and knowledge required by the engineering to understand the various operations and identify the cost estimation based on technicality and quality standard.

Course Contents:

Unit 1

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

Unit 2

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

Unit-3

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost

Unit-4

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding

Unit-5

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost.

Course Learning Outcomes (CLOs):

At the end of this course, the students will be able to

- Understand the concepts of process planning and cost estimation for various products.
- Understand the conceptual clarity about project organization and feasibility analysis of market in terms of technicality, financial and economics.

Text Books:

- Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
- Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.

Reference Books:

- Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107238/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%

Total Internal Assessment

Course code: PEC-MEL 431 **Course Name:** Principles of Management
Course credits : 3 **Total contact Hours :** 40 hrs

Course Objectives:

- To understand the principles of management and their application to the functioning of an organization
- To provide them tools and techniques to be used in the performance of the managerial job
- To enable them to analyze and understand the environment of the organization
- To help the students to develop cognizance of the importance of management principles

Course description:
This course is an introductory course on management process from managers perspective. The course seek to help students acquire the requisite knowledge, skills and abilities needed to successfully manage the organization. Through this course the student will practice the ability to think and examines logically the working of organisations and its functions. The main objective of this course is to help the student aware towards varied management principles

Course Contents:
Unit 1
Definition of management, science or art, manager vs entrepreneur; Types of managersmanagerialroles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship,partnership, company, public and private enterprises;
Unit-2
Organization culture and environment; Current trends and issues in management. Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.
Unit-3
Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management,
Unit-4
Career planning and Management. Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.
Unit-5
Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Learning Outcomes (CLOs):
Upon completion of this course, the students will be able to

- Get a clear understanding of management functions in an organization
- Demonstrate the roles, skills and functions of management

Text Books:

- Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.

- Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.

Reference Books:

- Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

Online links for study and reference materials:

https://nptel.ac.in/courses/110/105/110105146/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL432 **Course Name:** Automobile Engineering

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

1. To familiarize with the terminology associated with Automotive Technology.
2. To understand the construction of Automobile.
3. To understand the working principles of various parts of Automobile.

Course Description:
This course is an introduction to learning of Automobile Engineering. Concepts will be applied in this course from previous courses you have taken like IC Engine, Transmission System, Machine Design, etc.

Course Contents:
Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicleaerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS). Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, Over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive. Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control. Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles,
application of Fuel Cells.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Have good idea of function of each automobile component
- Have a clear idea about the overall vehicle performance

Text books:
1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.

Reference books:

1. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
2. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL 433 **Course Name:** Design of Transmission Systems

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

1. To familiarize with the terminology associated with Power transmission.
2. To learn about the design procedures for mechanical power transmission components
3. To understand the working principles of various types of transmission

Course Description:
This course is an introduction to learning of design concepts for the designing of transission systems. Concepts will be applied in this course from previous courses you have taken like that from Machine Design, Material science, heat and mass transfer, etc.

Course Contents:
Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears. Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears. Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications. Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Design transmission systems for engines and machines.

Text Books:
1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.

Reference books:

1. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
2. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course code: PEC-MEL 435 **Course name:** Energy Conservation and Management
Course credits : 3 **Total contact hours :** 40 hrs

Course Objectives:

- To understand the energy data from industries and carry out energy audit for energy savings
- To impart knowledge in domain of energy conservation
- To bring out energy conservation potential business models in order to give business opportunities across various segments
- To inculcate knowledge and skills about assessing the energy efficiency of an entity.

Course description:
This course has been identified as a key instrument to reduce greenhouse emissions, reduce waste in the various industrial sectors. This course describes about the need of renewable energy resources and its utilization for generation of clean power. Through this course the students will be able to understand various dimensions of energy management required across various industrial power projects segments.

Course Contents:

Unit-1
Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization;

Unit-2
Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing. Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics;

Unit-3
Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting. Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Unit-4
Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

Unit-5
Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Course Learning Outcomes (CLOs):
Upon completion of this course, the students will be able to

- Perform of energy auditing for the energy consumption of industries.
- Obtain knowledge about energy conservation policy, regulations and business practices
- Develop innovative energy efficiency solutions and demand management strategies

Text Books:

- Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization,Hemisphere Publ., Washington, 1988..

- Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press Oxford,

Reference Books:

- Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
- Energy Manager Training Manual , Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanager training.com).

Online links for study and reference materials:

https://nptel.ac.in/courses/112/105/112105221/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-MEL 435 **Course Name:** Total Quality Management

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the concept of Quality
- To understand the Implication of Quality on Business
- To Implement Quality Implementation Programs
- To have exposure to challenges in Quality Improvement Programs

Course Description:

Total quality management (TQM) is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement. It involves all departments and employees into improvement of rocesses and products. It helps to reduce costs and to meet and exceed needs and expectations of customers and other stakeholders of an organization. TQM encompasses the concepts of business and social excellence that is sustainable approach to organization's competition, efficiency improvement, leadership and partnership.

Course Contents:

Unit-I

Quality Concepts Evolution of Quality control, concept change, TQM Modern concept, Quality concept in Design, Review off design, Evolution of proto type. Control on Purchased Product Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality Methods and Techniques for manufacture, Inspection and control of product, Quality in Sales and services, Guarantee, analysis of claims

Unit-II

Quality Management Organization structure and design, Quality function, decentralization, Designing and fitting organization for different type's products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme. Human Factor in Quality Attitude of top management, co-operation, of groups, operators attitude, responsibility, causes of operators error and corrective methods.

Unit-III

Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, and use of control charts. Attributes of Control Charts Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart.

Unit-IV

Defects Diagnosis and Prevention Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle

Unit-V

IS0-9000 and its concept of Quality Management’s 9000 series, Taguchi method, JIT in some details

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

know business excellence models and be able assess organization‘s performance making reference to their criteria;

know the principles of total quality management and peculiarities of their implementation;

Be able to use quality management methods analyzing and solving problems of organization;

know prerequisites of evolution of total quality management and significance of quality gurus‘ works to the management of modern organizations.

Text books:

- Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
- Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

Reference books:

- Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
- Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Online links for study & reference materials:

https://nptel.ac.in/courses/110/104/110104080/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OEC-ME201 **Course Name:** Nanotechnology and Surface Engineering

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- The general goal of the course is to provide an introduction to and an overview over nanotechnology (NT).
- Surface engineering (SE) is a sub-discipline of Materials Science and Materials Engineering which deals with the surface of a solid and its modifications.
- The primary goal of SE of nanomaterials is to modify the properties of surface to improve its electrical and thermal properties, and to improve the compatibility of nanomaterials with some matrix when they are used as reinforcing fillers in composites for high performance applications.

Course Description:

The purpose of this course is to provide an advance understanding of Nanotechnology and Surface Engineering. This course encourages engineering students to solve industrial problems with engineering and nano technology tools.

Course Contents:

Unit-I

Introduction Overview of properties of nanostructures and nanomaterials. How the performance of nanomaterials come about: size, structure, Mechanism-property-performance pathway

Unit -II

Synthesis of Nano Structure. Template based nano synthesis, Electrochemical deposition and Electrophoretic deposition, Colloidal dispersion filling, Melt and solution filling, Deposition by centrifugation, Converting through chemical reactions, Electro spinning Current trends in surface modification of nanomaterials, Modified. Nanomaterials: In-use for consumer products, Main problems in synthesis of modified Nanomaterial.

Unit-III

Supercritical Fluids Introduction, Physicochemical Properties, Solubility, Viscosity, Diffusion, Thermal Conductivity, Applications, Purification and Extraction, Synthesis, Nanoporous Materials- Silicon, Zeolites, mesoporous materials, nanomembranes and carbon nanotubes, AgX photography, smart sunglasses, and transparent conducting oxides, molecular sieves, nanosponges.

Unit-IV

Deposition and surface modification methods, Physical vapor deposition, Chemical vapor deposition, Advanced surface modification practices, Advantages of deposition for surface modification. Need of advanced methods for surface and coating testing, Size dependency in nanostructures of nanocoating's, Size effect in electrochemical properties of nanostructured coatings, Size effect in Mechanical properties of nanostructured coatings, Size effect in physical and other properties of nanostructured coatings.

Unit-V

Surface phenomena Introduction to Adsorption, Desorption and Condensation, catalysis and Surfactants at solid-liquid interfaces. **Catalysis:** At Solid Surfaces (Heterogeneous Catalysis), Interfacial synthesis (Phase transfer Catalysis), Bio and Synthetic Enzymes, Active Sites, Molecular Mechanisms, Molecular simulations.

Course Learning Outcomes (CLOs):

After learning the course, the students should be able:

- Understand difference between properties Nanomaterial and conversion materials.
- To understand about materials and their properties at the atomic level, including an understanding of the intimate relationship between scale and size, nanostructure and the properties of materials.
- Understand the application of Nanotechnology.
- Understand the template based nano synthesis
- Understand the physical, chemical and mechanical properties of nanomaterials.

Text books:

- Nanostructures & Nanomaterials: Synthesis, Properties &Applications, G. Cao, Imperial College Press, 2004.
- Principles of Colloid and Surface Chemistry, Paul C. Hiemenz, Marcel Dekker, any edition starting with the 2nd edition, 1986.
- Handbook of Nanoceramics and their Based nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

Reference books:

- Chemistry of Nanomaterials: Synthesis, properties & applications, Volume-I – CNR Rao, A Muller & AK Cheetham
- "Nanostructured Materials and Nanotechnology", Hari Singh Nalwa, Academic Press Inc. (London), 2001
- Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.

- Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107248/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **PCC-EME 803** **Course Name:** Enterpreneurship Development

Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Description:

This course is an introduction to learning and applying the principles required to study the objective of Enterpreneurship and its understanding .

Course Contents:

UNIT I

Entrepreneurship: Definition, growth of small scale industries in developing countries and their positions Vis-à-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; Government policy for small scale industry

UNIT II

Project Identification: Assessment of viability, formulation, evaluation, field study and collection of information, demand analysis. Preparation of project report.

UNIT III

Economic evaluation: Project viability, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning, Preparation of 'Profit and Loss Account' and 'Balance Sheet'.

UNIT IV

Project planning and control: Planning and production control, quality control, marketing, industrial relations, advertisement, wages and incentives, inventory control

UNIT V

Laws concerning entrepreneur: partnership laws, business ownership, sales tax, income tax and workman compensation act. Role of various national and state agencies which render assistance to small industries.

Course Learning Outcomes(CLOs) :

Upon completion of this course, students will be able understand the process of developing small sale industries and enterpreneurships.

Text books:

1. Entrepreneurship Development: S S Khanka, S Chand & Co Ltd.
2. Entrepreneurship: Hisrich R D and Peters M P 5th Ed.,Tata McGraw Hill

Reference books:

- Entrepreneurship: David H Holt, New Venture Creation

Online links for study & reference materials:

https://nptel.ac.in/courses/112/106/112106286/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: **Course Name:** Design of Bearings and shafts
Course Credit: **Total Contact Hour:** 40hr
Course Objective:

- To introduce students to the design and theory of common bearings and shafts elements. Also, give students experience in solving design problems involving bearings and shafts elements.
- To require the student to prepare professional quality solutions and presentations to effectively communicate the results of analysis and design

Course Description:

One of the driving forces in development is that of creativity and perfection. In this course module, students will learn the fundamental aspects which are required in the world of entrepreneurship. This course is central to developing student's ability to analyze, design and/or select machine elements and therefore involves economic, societal, safety and manufacturing aspects. In addition to technological considerations, the team projects help develop ability to work in teams, address open-ended engineering problems and written communication via reporting the results.

Course Contents:

Unit-I

Introduction: tribology and hydrodynamics; factors affecting choice of bearing; characteristics; types of friction in sliding element bearing; viscosity of lubricants;

Unit-II

Sliding contact bearings : Bearing classification; Types of sliding contact bearings; Petroffs relation for power loss; unstable and stable lubrication; hydrodynamic theory of bearing: load carrying capacity of bearing; heating of bearings; practical bearing design; finite length bearings; pressure fed beari; bearing materials: bearing bronzes, babbits, copper lead alloys, aluminium tin alloy, other bearing materials; bearing types; design of journal bearing.

Unit-II

Rolling contact bearings: Types of rolling contact bearing: radial ball bearings, angular contact ball bearings, roller bearings; friction torque due to load; frictional torque due to viscous churning of lubricants; heating of roller bearing; rolling bearing geometry; stress and deformation in rolling element; bearing deflection; permanent deformation in bearings; fatigue of rolling bearing; selection of bearing; load on bearing; combined bearing load; bearing life; equivalent load; bearing dimension code.

Unit-III

Shafts: Materials for shafts; strength of shafts under torsion and bending; factor of safety in shafts: fatigue strength reduction factors, modified moments of inertia of shaft section; stiffness of shafts: factors affecting shaft deflection. Complete design calculation and checking of stress concentration, shafts for power transmission through belts and gears. Shaft vibrations.

Course Learning Outcomes (CLOs):

At the end of this course students will demonstrate the ability to

- Understand the design of shaft and bearings
- Understand the basic design procedure for bearings.
- Select standard components with their specifications from manufacturers catalogue

Textbooks:

- Machine Design by Abdul Mubeen; Khanna Publishers
- Machine Design by Shiegley; McGraw Hill
- Design of Machine Elements by Bhandari, McGraw Hill Education

Reference books:

- Machine Design by Black And Adams, McGraw Hill Education
- Design of Machine Elements by Spotts

Online links for study & reference materials:

- https://nptel.ac.in/courses/112/105/112105124/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: EME 705 **Course name:** Human Resource Management

Course Credits: 4 **Total contact Hours:** 40 hrs

Course Objectives:

- To enable the students to understand the HR management and system at various levels in general and in certain specific industries or organizations
- To develop relevant skills necessary for application in HR related issues
- To enable the students to focus , analyse and integrate the understanding of various HR conce3pts along with domain concept in order to take correct business decisions

Course Description:

This course describes the basic principles of human resource management. It describes how the effectiveness of organisation depends upon the organization employees, their attitude, behaviour and satisfaction with their jobs. This course also talks about how the basic ethics, values, sense of fair judgement directly effects firm's productivity. The basic objective of this course is to make students aware of basic aspects of human resource management to be able to understand and survive in today's competitive business environment.

Unit- I

Human Resource Management - Definition - Objectives - Functions - Scope - Importance - HRM in India - Evolution of HRM - Computer Application in Human Resource Management - Quality of a good Human Resource Managers - Human Resource Planning - Job Analysis, Job description and Job Specification.

Unit- 2

Recruitment and Selection - Sources of Recruitment - Selection Process - Test Types - Interview Types - Career Planning - VS Man Power Planning and succession Planning - Career Planning - Process - Career Development - Placement and Induction.

Unit-3

Training - Methods of Trading - Executive Development - Performance Appraisal - Methods of Performance Appraisal - Transfers - Promotion - Wage & Salary Administration - Wage Boards and Pay Commission - Wage Incentive - Fringe Benefits - Employees Welfare - Safety and Health Measures - Grievance Procedures - Redressal of Grievances.

Unit-4

Industrial Relations - Meaning & Characteristics Industrial Relations - Parties to Industrial relations - Nature of Trade Unions - Problems of Trade Union - Measures to Strengthen Trade Union Movement in India - Causes for Industrial Disputes - Settlement of Industrial Disputes.

Unit-5

Collective - Bargaining - Features - Pre-requisite of Collective Bargaining - Agreement at different levels - Workers Participation in Management - Objectives for Successful Participation.

Course Learning Outcomes (CLOs):

After completing this course the student will be able to

- Effective manage and plan key human resource functions within organizations
- Examine current issues, trends, practices and processes in HRM
- Problem-solve human resource challenges
- Develop effective written and oral communication skills

Text Books :

- Human Resource Management - Dr. C.B. Gupta - Sultan and Sons.
- Personnel & Human Resource Management - P. Subba Rao - Himalaya Publishing House.
- Human Resource and Personnel Management - K. Aswathappa - Tata Mc Graw Hill Publishing Co. Ltd.
- Personnel Management & Human Resources - C.S. Venkata Rathnam & B.K. Srivastava. TMPL.

References Books:

- Dynamics of Industrial Relations - Dr. C.B. Memoria, Dr. Satish Memoria &S.V. Gankar - Himalaya Publishing House.
- Performance Appraisal, Theory and Practice - AIMA - Vikas management Series, New Delhi - 1986.
- Human Resource Management: Pattanayak pH 1.2002

Online links for study and reference materials:

https://nptel.ac.in/courses/110/105/110105069/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%

Total Internal Assessment

Course Code: **Course Name:** Design of Thermal systems
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

This course will provide students with the tools to analyze and design energy systems

Course Description:

The course focuses on the main lines of Design of Thermal system: Heat Exchangers, condensation of single vapours etc. An ideal cooling design achieves the desired junction temperatures, is compact in size, low in cost, adaptable enough to fit into system designs

Course Contents:

Unit-I

CLASSIFICATION OF HEAT EXCHANGERS: Introduction, Recuperation & regeneration, Tabular heat exchangers, Double pipe, shell & tube heat exchanger, Plate heat Exchangers, Gasketed plate heat exchanger. Spiral plate heat exchanger, Lamella heat exchanger, Extended surface heat exchanger, Plate fin and Tabular fin. Basic Design Methods of Heat Exchanger: Introduction, Basic equations in design, Overall heat transfer coefficient, LMTD method for heat exchanger analysis, Parallel flow, Counter flow. Multipass, cross flow heat exchanger design calculations:

Unit-II

DOUBLE PIPE HEAT EXCHANGER: Film coefficient for fluids in annulus, fouling factors, Calorific temperature, Average fluid temperature, The calculation of double pipe exchanger, Double pipe exchangers in series parallel arrangements. Shell & Tube Heat Exchangers: Tube layouts for exchangers, Baffle heat exchangers, Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter, The true temperature difference in a 1 -2 heat exchanger. Influence of approach temperature on correction factor. Shell side pressure drop, Tube side pressure drop, Analysis of performance of 1 -2 heat exchanger and design of shell & tube heat exchangers, Flow arrangements for increased heat recovery, the calculation of 2-4 exchangers.

Unit-III

CONDENSATION OF SINGLE VAPOURS: Calculation of horizontal condenser, Vertical condenser, De-Super heater condenser, Vertical condenser-sub-Cooler, Horizontal CondenserSub cooler, Vertical reflux type condenser. Condensation of steam.

Unit-IV

VAPORIZERS, EVAPORATORS AND REBOILERS: Vaporizing processes, Forced circulation vaporizing exchanger, Natural circulation vaporizing exchangers, Calculations of a reboiler. Extended Surfaces: Longitudinal fins. Weighted fin efficiency curve, Calculation of a Double pipe fin efficiency curve. Calculation of a double pipe finned exchanger, Calculation of a longitudinal fin shell and tube exchanger

Unit-V

DIRECT CONTACT HEAT EXCHANGER: Cooling towers, relation between wet bulb & dew point temperatures, The Lewis number and Classification of cooling towers, Cooling tower internals and the roll of fill, Heat Balance. Heat Transfer by simultaneous diffusion and convection, Analysis of cooling tower requirements, Deign of cooling towers, Determination of the number of diffusion units, Calculation of cooling tower performance.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Students should be able to integrate material from the basic courses in thermodynamics,
- Fluid mechanics, and heat transfer into the design of various thermal systems;
- Gain experience in using computer techniques in modeling and simulating typical thermal systems; perform economic calculations involving time and interest;
- And be familiar with the environmental impact of energy systems.
- Design a thermofluid system involving moving fluids, heat transfer, and conversion of energy between heat and work.

Text books:

- Introduction to Heat Transfer, by Bergman, Lavine, Incropera & DeWitt, 6th Edition, John Wiley and Sons, 2011.
- Fundamentals of Fluid Mechanics, by Munson, Young, Okiishi, and Huebsch, 6th Edition, John Wiley and Sons, 2009.

Reference books:

- Fundamentals of Engineering Thermodynamics, by M. Moran and H. Shapiro, 6th Edition, John Wiley and Sons, 2008.

Online links for study & reference materials:

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

MASTER OF TECHNOLOGY

Biotechnology

Program Outcomes (POs)

Students will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences.

3. Acquire knowledge in domain of biotechnology enabling their applications in industry and research.

4. Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology

5. Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists.

Semester-1

Paper code	Subject	L	T	P	Marks(ISE)	Marks(ESE)	Total	Credit
BPCT1	Applied Biochemistry & Molecular Biology	3	0	2	40	60	100	3
BPCT2	Bioprocess Engineering & Technology	3	0	2	40	60	100	3
BPE1x	Program Elective-1 1. Immunology & Vaccine Technology 2. Quality Control in Biotechnology 3. Applied Clinical Research 4. Agricultural Biotechnology	3	0	0	40	60	100	3
BPE2x	Program Elective-2 1. Biological treatment of waste water 2. Quality control in Biotechnology 3. Applied clinical research	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
BPCL1	Applied Biochemistry & Molecular Biology Lab	0	0	2	40	60	100	2
BPCL2	Bioprocess Engineering & Technology Lab	0	0	2	40	60	100	2
Total							**800**	**18**

Semester-2

Paper code	Subject	L	T	P	Marks(ISE)	Marks(ESE)	Total	Credit
BPCT3	Bioinformatics	3	0	0	40	60	100	3
BPCT4	Recombinant DNA Technology	3	0	0	40	60	100	3
BPE3x	Program Elective-3 1. Genetic Engineering 2. Applied Food Biotechnology 3. Molecular Modeling & Industrial Application	3	0	0	40	60	100	3
BPE4x	Program Elective-4 1. Bioreactor Analysis & Design 2. Enzyme Technology & Industrial Application 3. Applied Bioenergy	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
BPCL3	Bioinformatics Lab	0	0	2	40	60	100	2
BPCL4	Recombinant DNA Technology Lab	0	0	2	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3

Paper code	Subject	L	T	P	Marks(ISE)	Marks(ESE)	Total	Credit
BPE5x	Program Elective-5 1. Tissue Culture Techniques 2. Diagnostic Techniques in Biotechnology 3. Fundamentals of Stem Cell Technology	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4

Paper code	Subject	L	T	P	Marks(ISE)	Marks(ESE)	Total	Credit
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**
GRAND TOTAL							**3000**	**68**

Open Elective

MOE01. Business Analytics

MOE02. Industrial Safety

MOE03. Operations Research

MOE04. Cost Management of Engineering Projects

MOE05. Composite Materials

MOE06. Waste to Energy

M. Tech Biotechnology (Regular)

Course Code: BPCT1 **Course Name:** Applied Biochemistry & Molecular Biology

Course Credit Hour: 3hr **Total Contact Hour:** 60hr

Course Objective:

The objective of the course is to enable the students to develop understanding in the basics of Molecular Biology and biochemistry. To provide basic knowledge on replication. Transcription and Translation. To provide knowledge on structures and functions of Bio-molecules.

Course Description:

Brief introduction to biomolecules, Interplay of macromolecules in a living cell, Major molecular events in the cell cycle, Architecture of microbial, animal and plant genome, Replication & transcription and their control in prokaryotes and eukaryotes, Features of genetic code, translation and its control, Posttranslational modifications, Gene structure & function, Molecular mechanism of gene expression, silencing of gene function, Extrachromosomal genetic elements, Transposable genetic elements and retroviruses, Molecular basis of cellular differentiation, Oncogenes and cancer, Epigenetic effects, Regulatory RNA, Genetic and metabolic disorders, Programmed cell death, Aging and senescence.

Course Content:

UNIT I

Structures and functions of Bio-molecules: Carbohydrates: classification, mono, di, oligo and polysaccharides. Lipids: fatty acids, simple, complex & derived lipids. Protein: Amino Acids Structure and function, Protein Structure Hierarchy. Nucleic acids: nucleosides, nucleotides, DNA & RNA.

UNIT II

Bioenergetics: Overview of principles of bioenergetics (free energy, enthalpy and entropy). Energy relationships between catabolic and anabolic pathways. Phosphoryl group transfers and ATP, Free-energy change for ATP hydrolysis.

UNIT III

Metabolism: Glycolysis, Gluconeogenesis, Respiration and Introduction to the Citric Acid Cycle, Electron Transport, Oxidative phosphorylation, Fatty Acid Catabolism: Fatty acid oxidation, Protein Metabolism: The Urea Cycle

UNIT IV

Gene structure, DNA & RNA as a genetic material, RNA World, packaging of DNA as chromosome, DNA replication- Prokaryotic and eukaryotic DNA replication, Mechanism of replication. Telomeres, telomerase and end replication. Role of telomerase in aging and cancer.

UNIT V

Transcription, genetic code, reverse transcription, mRNA processing. Translation, Gene regulation,operons: Lac operon, TRP, operon, transposons.

Course Learning Outcomes (CLOs):

1. Apply chemical principles and energy transfer to molecular life processes,
2. Summarize fundamental concepts across the biological sciences with focus on flow of information and molecular structure/function relationships
3. Demonstrate proficiency in experimental design, laboratory methodology, and data analysis,
4. Implement modes of communication relevant to life-science professions, and
5. Create effective team-based work groups

Text / Reference Books

1. Biochemistry- L.Stryer , Third Edition
2. Biochemistry- Voet & Voet.
3. Principles of Biochemistry- A.Lehninger , CBS Publishers and Distributors , 1987.
4. Biochemistry- S C Rastogi, Tata McGraw- Hill Publishing Com. Ltd., II ND Edition, 2003.
5. Zubay. Biochemistry. 4th ed. William C. Brown Publication, 1998.
6. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. Molecular Biology of Gene. 6th The Benjamin / Cummings Pub. Co. Inc., 2008.
7. Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000.
8. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular biology of the Cell. 4th ed. Garland publishing Inc., 2002.
9. Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox.

Online links for study & reference materials:

https://www.easybiologyclass.com/topic-biochemistry/

Assessment method:

(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3 (Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05

Course Code: BPCT2

Course Name: Bioprocess Engineering & Technology

Course Credit Hour: 3hr

Total Contact Hour: 30hr

Course Objective:

The objective is to enable students to study a broad base of topics in the fundamentals of engineering focused on the chemical and biological processing of raw materials from sustainable sources.

Course Description:

Bioprocess Engineering Study of the engineering concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemical.

Course Content:

UNIT I

Historical development of bioprocess technology, An overview of traditional and modern applications of biotechnological processes, General requirements of fermentation processes, Basic design and construction of fermenter and ancillaries, Main parameters for monitoring & control of fermentation processes, Different raw materials used in fermentation industry and their pretreatment, Medium for plant cell culture and animal cell culture, Medium design of commercial media for industrial fermentations-Plackett burman design, response surface methodology, simplex design.

UNIT II

Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic Efficiency of growth.

UNIT III

Mass transfer includes transport phenomena in bioprocesses, Factors affecting oxygen transfer rate in bioreactors, Techniques for measurement of volumetric oxygen transfer coefficient, Fluid rheology and factors affecting bioreactor processes, Flow Patterns in agitated tanks, Mechanism & Power requirements of mixing, Scale up of mixing systems.

UNIT IV

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes, Induction, nutritional repression, carbon catabolite repression, Crabtree effect, feedback inhibition and feedback repression, Concept of Overproduction of metabolites, Case studies on production of Lactic acid, Glutamic acid, Penicillin, Microbial Lipase And Protease, Recombinant Insulin, Interferons, Hepatitis Vaccines etc. Case studies should deal with strain improvement, medium designs, process optimization technology.

UNIT V

Unit Operation: Filtration, filter aids, filtration Equipment and filtration theory, Centrifugation process and its equipment's, Cell disruption, Aqueous Two-Phase Liquid Extraction. Adsorption process and its operations, Chromatography: Theory and mechanism, Scaling-up chromatography.

Course Learning Outcomes (CLOs):

Students will be able to:

1. Apply the concepts of basic chemical engineering principles in a bioprocess
2. Produce bio-products on an industrial scale using fermenters.
3. Operate and optimize process parameters in a fermenter for producing industrial products.

Text Book

1. Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.
2. Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
3. Biochemical Engineering and Biotechnology Handbook" by B. Atkinson & F. Mavituna, 2nd Ed. Stockton Press.
4. Bioprocess Engineering Principles" by Pauline M. Doran, Academic Press.
5. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.
6. Lee J.M, Biochemical Engineering 2nd ed, Prentice Hall, 2000.
7. Principles of Cell Energetics": BIOTOL series, Butterworth - Heinemann.
8. Biotechnology" Vol.4 Meaning Modelling and Control Ed. K.Schugerl, VCH (1991).
9. Unit operations of Chemical Engineering" 5th ed. by W L McCabe, J C Smith and P. Harriot.
10. Mc Graw-Hill (1993).
11. Diffusion" by E L Cussler, Cambridge University Press (1984).

Online links for study & reference materials :

https://bioprocessing.weebly.com/bioprocess-technology.html

Assessment method:

(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3 (Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%

Total Internal Assessment **-40%**

Course Code: BPE11

Course Name: Immunology & Vaccine Technology

Course Credit Hour: 3hr

Total Contact Hour: 30hr

Course Objective:

The objective of this course is to provide students with detail understanding of different cells, organs and factors of the immune system and their organization and diversity, and their specialized functions. The course will provide basic concepts of different immunological techniques and knowledge about role of immune system in the pathogenesis of different disease like infectious disease, Cancer, autoimmune disease, AIDS etc.

Course Description:

Immunology is the study of the immune system and is a very important branch of the medical and biological sciences. The immune system protects us from infection through various lines of defense. If the immune system is not functioning as it should, it can result in disease, such as autoimmunity, allergy and cancer. It is also now becoming clear that immune responses contribute to the development of many common disorders not traditionally viewed as immunologic, including metabolic, cardiovascular, and neurodegenerative conditions such as Alzheimer's.

Course Contents

UNIT I

Fundamental concepts and anatomy of the immune system, Components of innate and acquired immunity, Humoral and Cell mediated immunity, Haematopoesis, Antigens , immunogens, haptens, Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

UNIT II

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants, Multigene organization of immunoglobulin genes, Immunological basis of self – non-self-discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity, Antigen processing and presentation- endogenous antigens and exogenous antigens.

UNIT III

A short history of vaccination, Active and passive immunization, General immunization practices, Vaccination of immunocompromised hosts, Vaccination of human immunodeficiency virus- infected persons, Vaccines, Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein

UNIT IV

Licensed vaccines, Viral Vaccine (Poliovirus vaccine-inactivated & Live, Rabies vaccines Hepatitis A & B vaccines), Bacterial Vaccine (Anthrax vaccines, Cholera vaccines, Diphtheria toxoid), parasitic vaccine (Malaria Vaccine).

UNIT V

The vaccine industry, Vaccine manufacturing, Evolution of adjuvants across the centuries, Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Vaccine safety and Legal issues.

Course Learning Outcomes (CLOs):

Students will be able to

1. explain role of immune cells and their mechanism in preventing the body from foreign attack and infectious disease, cancer and other disease development
2. Apply the knowledge of immune associated mechanisms in medical biotechnology research.
3. design experiment to see effect of drug molecule on immune response
4. Carry out immunological techniques in industry.
5. Able to apply the concept of vaccine technology in new vaccines development.

Text/Reference Books:

1. Kuby, RA Goldby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications. 1999. 4. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
4. Stanley A. Plotkin & Walter Orenstein & Paul A. Offit, Vaccines, 6th Edition 2013 BMA Medical Book Awards Highly Commended in Public Health! Elsevier Publication.
5. Roitt's Essential Immunology. 11th ed. P. Delves, et al., ed., Blackwell Publishing, 2006.

Online links for study & reference materials:

https://www.immunology.org/public-information/what-is-immunology

Assessment method:

(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3 (Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**-40%**

Course Code: BPE21 **Course Name: Biological Treatment of Waste Water**

Course Credit Hour: 3hr **Total Contact Hour: 30 HRS**

Course Objective:

The objective of this course is to address the deficient access to the knowledge by offering a broad and thorough overview on (conventional and innovative) biological wastewater treatment processes and practices. The modern approach of modelling and simulation to wastewater treatment plant design and operation - be it activated sludge, biological nitrogen and phosphorus removal, secondary settling tanks or biofilm systems - can be embraced with deeper insight, advanced knowledge and greater confidence.

Course Description:

This course seeks to address the quantity, complexity and diversity of the developments in the wastewater treatment profession, particularly in developing countries where access is not readily available to advanced level courses in wastewater treatment.

Course Contents:

UNIT I-ACTIVATED SLUDGE PROCESS-PROCESS ANALYSIS AND SELECTION

Characteristics of Activated Sludge (aerobic and anaerobic); Analysis of Data– Mass Balance Analysis. Reactors used in waste water treatment- Up Flow Anaerobic Sludge Blanket (UASB), Two-stage, Aerobic UNI Tank System (TSU-System, Route Zone Treatment, Submerged Aerobic Fixed Film (SAFF) Reactor, and Fluidized Aerobic Bioreactor (FAB).

UNIT II-AEROBIC FIXED-FILM & ANAEROBIC TREATMENT PROCESSES

Biofilm process considerations; Trickling Filters and Biological Towers; Rotating Biological Contactors; Granular – Media Filters; Fluidized – Bed & Circulating Bed- Biofilm reactors. Hybrid Biofilm/suspended growth processes. Anaerobic Processes: Methanogenesis, process chemistry and microbiology; process kinetics and factors for the design of anaerobic digestors.

UNIT III-ADVANCED WASTE WATER TREATMENT

Technologies used in advanced treatment-Classification of technologies; Removal of Colloids and suspended particles-Depth Filtration, Surface Filtration, Membrane Filtration Absorption, Ion Exchange, Advanced oxidation process, Activated Carbon, Air Stripping, Heavy Metals Removal, Steam Stripping, Chemical Precipitation, and Electrolysis.

UNIT IV-BIOLOGICAL PHOSPHORUS REMOVAL

Nitrification & Denitrification Processes**:** Biochemistry and Physiology of Nitrifying Bacteria; Common process considerations; One sludge versus two sludge nitrification. Physiology of Denitrifying Bacteria; Tertiary Denitrification; One- sludge denitrification, Normal Phosphorus Uptake into Biomass; Mechanism for Biological Phosphorus Removal; Enhanced Biological Phosphorus Removal by Bacteria and Algae.

UNIT V-ENVIRONMENTAL CONCERNS & RECYCLING OF WASTES

Environmental regulations and technology- Regulatory Concerns, Technology; Laws, regulations and permits, Air, Water, Solid Waste, Environmental Auditing, National Environmental Policy act, Occupational Safety and Health Act (OSHA), Storm Water Regulations; Technology (waste water); Recycling of Industrial wastes: paper, plastics, leather and chemicals.

Course Learning Outcomes (CLOs):

Students will be able to

1. Describe the prime objective of wastewater treatment and sanitation.
2. Determine the stoichiometric and kinetic parameters of the different metabolic processes of the microorganisms involved during the biological wastewater treatment process
3. Critically determine and analyse quantity and quality characteristics of wastewaters
4. Design and critical assess different wastewater treatment systems and configurations performing biological organic matter, nitrogen as well as phosphorus removal.
5. Design and critically evaluate different disinfection treatments.

Text/Reference Books:

1. Wastewater Engineering: Treatment Disposal Reuse by Metcalf & Eddy
2. Environmental Biotechnology : Principles and Applications by Bruce E. Rittmann
3. Waste water Engineering Treatment and Reuse: McGraw Hill, G. Tchobanoglous,FI Biston, 2002.
4. Industrial Waste Water Managemnet Treatment and Disposal by Waste Water McGraw Hill III Edition 2008.
5. Biological Wastewater Treatment", Second Edition, Marcel Dekker, Inc., New York,
6. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.

Online links for study & reference materials:

https://www.cedengineering.com/courses/biological-wastewater-treatment-ii-mbbr-processes

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-4	- 05%
Assessment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: PE22 **Course Name: Quality Control in Biotechnology**

Course Credit Hour: 3hr **Total Contact Hour: 30 HRS**

Course Objective:

The course focuses on the quality requirements for the production and control of biologics and drugs and the differences between quality control and quality assurance and their interaction with manufacturing.

Course Description:

Quality control is an important area in many Biotechnological companies. The people who work in quality control perform different kinds of tests to ensure the identity, purity, and activity of the product the company sells. The exact tests depend on the product. Quality control technicians may also test materials that are purchased from different vendors.

Course Contents:

UNIT I

Concept and evolution of quality control and quality assurance. Total Quality Management, Philosophy of GMP and cGMP. Preparation of audit, Conducting audit, Audit Analysis, Audit Report and Audit follow up Quality control laboratory responsibilities: GLP protocols on non- clinical testing control on animal house, data generation, integration and storage, standard test procedure, retention of sample records. CPCSEA guidelines.

UNIT II

Quality review and batch release document of finished products, annual product quality review and parametric release, Audits, quality audits of manufacturing processes and facilities, audits of quality control.

UNIT III

Good documentation practices, route cause analysis, corrective action preventive action (CAPA), out of specifications (OOS) and out of trend (OOT), Clinical studies- ICH GCP (E6) guidelines, post marketing surveillance, Pharmacovigilance.

UNIT IV

BABE (bioavailability and bioequivalence) studies, Concepts and management of contract manufacturing guidelines, Statistical Tools for Quality Control and Precision, Tools of Problem Solving and Continuous Improvement.

UNIT V

Introduction, scope and importance of IPR, Concept of trade mark, copyright and patents Product registration guidelines – CDSCO, USFDA, Concept of ISO 9001:2008, 14000, OSHAS guidelines, Quality Strategy for Indian Industry, Brief concept of IND, NDA, ANDA, SNDA and PAT.

Course Learning Outcomes (CLOs):

Students will be able to:

1. Develop a thorough understanding of regulatory compliance and good manufacturing practices
2. Interpret research or operational data.
3. Test and evaluate quality of materials or finished products.
4. Record research or operational data.
5. Maintain and calibrate laboratory or technical equipment.
6. Prepare information or documentation related to legal or regulatory matters. Inspect areas for compliance with sanitation standards.

Text / Reference Books:

1. Sharp J. Good Pharmaceutical Manufacturing Practice: Rationale and Compliance. CRC Press; 2005.
2. Gad SC. Pharmaceutical Manufacturing Handbook: Production and Processes. John Wiley & Sons; 2008.
3. Steinborn L. GMP/ISO Quality Audit Manual for Healthcare Manufacturers and Their Suppliers, Sixth Edition, (Volume 1 - With Checklists and Software Package). Taylor & Francis; 2003.
4. Kolman J, Meng P, Scott G. Good Clinical Practice: Standard Operating Procedures for Clinical Researchers. Wiley; 1998
5. .Waller P. An Introduction to Pharmacovigilance. John Wiley & Sons; 2011.
6. Niazi S. Handbook of Bioequivalence Testing. CRC Press; 2007.
7. Chalmers AA. International Pharmaceutical Registration. Interpharm Press; 2000.
8. Edwards AJ. ISO 14001 Environmental Certification Step- by-Steps: Revised Edition. Butterworth-Heinemann; 2003.
9. Mantus D. FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics. Informa Healthcare USA; 2008.

Online links for study & reference materials:

https://www.mobiloitte.com/quality-control-in-biotechnology

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BPE23 **Course Name: Applied Clinical Research**

Course Credit Hour: 3hr **Total Contact Hour: 30 HRS**

Course Objective:

The Clinical Research course is rooted in the belief that clinical research training is critical to professional development in health care. Clinical research course Designed to provide learners with the foundational knowledge and skill sets required to produce high-quality clinical research.

Course Description:

Clinical trials and regulatory affairs publishes innovative, developmental and original research on validated experimental design, methods, representation and interpretation of clinical research and drug trials. Additionally, the journal publishes original research articles, reviews, short communications and thematic journal issues. Published work is based on solid clinical, scientific and statistically relevant results that lead to advancements in clinical medicine, clinical research, regulatory affairs and human subject protection in the areas of biological advances, drugs, bio-therapeutics and devices.

Course Contents:

UNIT I: Introduction to clinical research

Basic pharmacology and drug development process, clinical research definition, Basic terminology used in clinical research, preclinical studies, Introduction to pharmaco economics, Types of clinical trials, single blinding, double blinding, open access, randomized trials and their examples, interventional study, Good Clinical Practices, Types and Scope of Clinical Research.

UNIT II: Clinical trials

New drug discovery process- purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each steps, Pre clinical toxicology: General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements, Phase-I, II, III, IV trials: Introduction and designing, Various phases of clinical trials, Post Marketing surveillance, methods & Principles of sampling, Inclusion and exclusion criteria, Methods of allocation and randomization, Informed consent process in brief monitoring, treatment outcome, Termination of trial, Safety monitoring in clinical trials.

UNIT III: Ethics & Regulations in Clinical research

Ethical Theories and Foundations, Ethics Review Committee and Informed Consent Process,Integrity & Misconduct in Clinical Research , unethical trials, thalidomide tragedy, Conflicts of Interest, Evolution and History of Regulations in Clinical Research, Study of various clinical trials (completed or ongoing) ,Patents US Regulatory Structure, Clinical Trial Application in India Import & Export of Drug in India , Investigational New Drug application (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA), Post Drug Approval Activities, PMS, FDA Audits and Inspections EU Regulatory Affairs, EMEA Organization and Function, INDIAN Regulatory system, Schedule Y- Rules and Regulations.

UNIT IV: Principles of controlled clinical trials

Clinical trial design (observational and interventional) protocol, consent in clinical trials, placebo, bias and methods to prevent bias, ethics in clinical trials, monitoring, problems and solutions of controlled clinical trials. Multicentre clinical trials, Requirements, regulations and feasibility, Designing of Protocol, CRF, e-CRF, IB, ICF, SOP BA/BE Studies Report writing, Publication, Improving patient enrolment and retention in Clinical Trials Other Clinical Studies- Pharmacoepidemiology, ADR monitoring, pharmacokinetic trials, quality of life studies.

UNIT V: Biostatistics and data management

Preparation of a successful clinical study, Study management, Project management Documentation, Monitoring, Audits and Inspections Pharmacovigilance Training in clinical research Budgeting in clinical research, Supplies and vendor management. Importance of statistics in clinical research Statistical considerations at the design, analysis and reporting stage. Data management, Data validation, SAE reconciliation, query management Software considerations.

Course Learning Outcomes(CLOs) :

Students will be able to:

1. Describe Good Clinical Practice (GCP) requirements and explain the legal and regulatory issues in clinical research
2. Construct a clinical research protocol and critique flawed and exemplary studies
3. Differentiate the key elements of successful study and site management
4. Examine ethical issues in clinical research and select appropriate approaches strategies to navigate
5. Practice the leadership and communication skills needed in a clinical research setting

6. Demonstrate an awareness of ethical practices and professional standards applicable to the field of clinical research
7. Exemplify the skills, attitudes and behaviours required to effectively communicate with various stakeholder groups engaged in clinical trails
8. Demonstrate personal management, leadership and project management skills

TEXT BOOKS and REFERENCES:

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
3. Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz
4. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
5. Drug interaction, Kven Stockley. Hamsten
6. Clinical pharmacology and drug therapy Grahame smith and Aronson,
7. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms,
8. Clinical Pharmacy and therapeutics Herfindal E T and Hirschman JL, Williams and Wilkins,
9. Methodology of Clinical Drug Trials, 2nd Edition. Spriet A., Dupin-Spriet T., Simon P. Publisher: Karger.

Online links for study & reference materials :

https://lecturenotes.in/download/note/18532-note-for-applied-physics-phy-by-anshuman

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

BPCL1: APPLIED BIOCHEMISTRY& MOLECULAR BIOLOGY LAB

1. Quantitative estimation of amino acids by ninhydrin reaction.
2. Quantitative estimation of proteins.
3. To separate lipids with the help of thin layer chromatography (TLC).
4. To verify the Lambert Beer's law with the help of UV absorption spectra of proteins.
5. Protein purification by ammonium sulfate precipitation.
6. Isolation of DNA and RNA from animal tissue and plant tissue.
7. Gel electrophoretic analysis of various DNA and their restriction digests
8. Transformation with plasmid and bacteriophage DNA
9. Restriction mapping of plasmid DNA
10. Blotting: northern blotting, southern blotting
11. PCR technique

BPCL2: BIOPROCESS TECHNOLOGY & ENGINEERING LAB

1. Determination of kinetic parameters for batch cultivation of yeast under shake flask conditions.
2. Determination of volumetric oxygen transfer coefficient (K_{La})
3. Determination of activation energy (Ea) of microbial strains.
4. Process optimization for enzyme production using specific experimental design.
5. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
6. Computational Design of Fermentative Process.
7. Fermenter designing and the study of various parts of fermenter and their function for microbial cell culture.
8. Fermentative production of Penicillin by using *Penicilium chrysogenum*.
9. Microbial production of enzymes Cellulase & Protease.
10. Ethanol production from molasses or starchy raw material.
11. Fermentative production of Wine from grapes.
12. Separation and purification of microorganisms from yogurt and cheese.
13. Fermentative production of alpha amylase under solid & submerged conditions.
14. Protein profiling of fermentation broth through dialysis procedure.
15. To study the Scale-up and Sterilization in Bioreactors.

Course Code: BPCT3 **Course Name:** Bioinformatics

Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective :

The objective of this course is to provide students with basic understanding and application of bioinformatics. The course will provide the basic concepts behind the sequence and structural alignment, database searching, protein structure prediction and computer based drug designing.

Course Description :

Bioinformatics is a new multidisciplinary field that includes the development and implementation of computational methods and tools suitable to handle, decipher and interpret the plethora of biomolecular data derived nowadays, acting as a bridge between bio- information and biological knowledge extraction.

Course Contents:

UNIT I

Introduction to Bioinformatics, Need for informatics tools and exercises, Bioinformatics resources: NCBI, EBI, ExPASy, RCSB. Significance of databases towards informatics projects. Primary and Secondary Databases. GenBank, DDBJ, EMBL, PIR, Uniprot-KB, SWISS-PROT, TrEMBL. Specialized databases: Pubmed, OMIM, Medical databases, KEGG, EST databases; Genome databases at NCBI, EBI, TIGR, SANGER. Overview of other popular tools for various bioinformatics exercises.

UNIT II

Introduction, The evolutionary basis of sequence alignment, the Modular Nature of proteins, Optional Alignment Methods, Substitution scores, substitution matrices, PAM, BLOSUM, Gap penalties, Statistical significance of Alignments, Pair wise sequence alignment algorithms, Practical Aspect of Multiple Sequence Alignment, Progressive and Iterative Alignment Methods, CLUSTALW, Database similarity searching, FASTA, BLAST, Low-Complexity Regions. PSI- BLAST, PHI-BLAST.

UNIT III

Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Tree - Building Methods-Distance based and character based methods, Evaluating Trees and Data- Boot strapping (parametric and non parametric), Phylogenetic softwares (CLUSTALW, PHYLIP etc), Conceptual numericals.

UNIT IV

Restriction mapping, Utilities, DNA strider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web based tools (MAP, REBASE); Primer design – need for tools, Primer design programs and software (PRIME3).

UNIT V

Sequencing methods, Bioinformatics tools and automation in Genome Sequencing, analysis of raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in detection of Polymorphisms, SNPs and their relevance, Bioinformatics tools in microarray data analysis. Tools for comparative genomics: BLAST2, AVID, Vista, MUMmer, COG, VOG. Usages of visualization software available in public domain like VMD, Rasmol, Pymol, SpdbViewer, Chime, Cn3D and GRASP. Rotameric Structures of Proteins (Conformational Flexibility), Canonical DNA Forms (DNA Sequence Effects).

Course Learning Outcomes(CLOs) :

Students will be able to:

1. Apply key concepts of different bioinformatics tools
2. Analyse sequence and structure bio-macromolecule data
3. Apply the knowledge of bioinformatics in the biotechnology research and industry
4. Use system biology for application in biotechnology

Text/ Reference Books:

1. Bioinformatics (Sequence and Genome Analysis)- David W. Mount, Cold Spring Harbor Laboratory Press, 2001.
2. Bioinformatics- Zoe Lacroix, Terence Critchlow, Morgan Kaufmann Publishersm, 2004.
3. Bioinformatics – From Genomics to Drugs, Violume 1; Basic Technoliges, Thomas Lengauer, Wiley- VCH, 2001.
4. Bioinformatics (Practical Approach): Sequence, Structure and Databanks – Des Higgins, OXFORD Univ. Press, 2003.
6. Bioinformatics Computer Skills - Gibas & Jambeck, O' Reilly, 2001, I Ed.
7. Bioinformatics Computing- Bryan Berjeron, Prentice-Hall of India, Private Ltd., 2003.
8. Computational Molecular Biology (An Algorithmic Approach)- Pavel A. Pevzner, Prentice- Hall of India, Private Ltd., 2004.

9. Introduction to bioinformatics- T K Attwood, D J Parry-Smith, Pearson Education, 2004.

Online links for study & reference materials :

https://www.coursera.org/lecture/bioinformatics-pku/what-is-bioinformatics-vQo1i

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**-40%**

Course Code: BPCT4

Course Name : Recombinant DNA Technology

Course Credit Hour: 3hr

Total Contact Hour : 30hr

Course Objective:

To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques in genetic engineering.

Course Description:

Recombinant DNA technology: A series of procedures that are used to join together (recombine) DNA segments. A recombinant DNA molecule is constructed from segments of two or more different DNA molecules. Under certain conditions, a recombinant DNA molecule can enter a cell and replicate there, either on its own or after it has been integrated into a chromosome

Course Contents:

UNIT I

Introduction to recombinant DNA Technology, Safety guidelines of rDNA research. Restriction endonucleases, DNA modifying enzymes, Vectors: plasmids, phage vectors, cosmids, phagemids, Yeast cloning vectors, Animal viruses, yeast artificial chromosomes, bacterial artificial chromosome. Cloning &Cloning strategies in yeast and *E. coli*, cloning of PCR product, construction and screening of genomic and cDNA library.

UNIT II

Sequencing of DNA, Molecular probes, PCR, Blotting and hybridization techniques, mutagenesis, mRNA isolation and cDNA synthesis, RFLP, RAPD, RT PCR. Selection of rDNA clones and their expression products: Direct and indirect methods, Gene Targeting, Gene Silencing.

UNIT III

Tailoring model plants and animals: transgenic animals and plants, techniques and experiments involved in creating transgenic mice, knockout mice.

UNIT IV

Nucleic acid sequence as diagnostic tools, DNA fingerprinting in consideration to clinical diagnosis & forensics, New drugs and therapies for genetic diseases, Metabolite engineering, Metabolic pathway engineering.

Course Learning Outcomes(CLOs) :

1. Major events in the development of rDNA technology. Introduction of rDNA into bacterial cells. Selection of transformants and recombinants – lac selection.
2. Learning tools and techniques in rDNA technology- DNA manipulative enzymes.
3. Acquire skills on techniques of construction of recombinant DNA - Cloning vectors and isolation of gene of interest.

Text Books:

1. Ausubel et al. (2002). Short Protocols in Molecular Biology. Wiley
2. Brown (2006). Gene Cloning and DNA Analysis - An Introduction. Blackwell
3. Glick and Pasternak (2003). Molecular Biotechnology. ASM Press
4. Krenzer and Massey (2000). Recombinant DNA and Biotechnology. ASM
5. Robertson et al. (1997). Manipulation & Expression of Recombinant DNA. AP
6. Sambrook et al. (2001). Molecular Cloning. CSHL
7. Primrose and Twyman (2006). Principles of Gene Manipulation and Genomics. Blackwell

Online links for study & reference materials :

https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%

Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BPE31 **Course Name:** Genetic Engineering

Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

1. This course offer students to learn the tools and techniques used in genetic engineering and recombinant DNA technology.
2. To make students learn the application of recombinant DNA technology in the field of biomedical, agriculture and environment.

Course Description:

Genetic engineering is the process of using recombinant DNA (rDNA) technology to alter the genetic makeup of an organism. Traditionally, humans have manipulated genomes indirectly by controlling breeding and selecting offspring with desired traits. Genetic engineering involves the direct manipulation of one or more genes. Most often, a gene from another species is added to an organism's genome to give it a desired phenotype.

Course Contents:

UNIT I

DNA Structure and properties; Enzymes used in Genetic Engineering; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridization techniques, Hybridization techniques; Chromatin Immunoprecipitation; DNA-Protein Interactions-Electromobility shift assay; DNaseI footprinting; Methyl interference assay

UNIT II

Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors, Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors; Expression vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies; Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors

UNIT III

Insertion of Foreign DNA into Host Cells; Transformation; Isolation of mRNA and total RNA; cDNA and genomic libraries and its construction; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries;

Southwestern and Far-western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression

UNIT IV

Primer design; Fidelity of thermostable enzymes; DNA polymerases; Concept of PCR, Types of PCR, Gene specific and degenerate primer design, linkers, adaptors, Fidelity of uDNA polymerase. Application of PCR. Chimeric protein engineering by PCR

UNIT V

Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene Therapy; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.

Course Learning Outcomes(CLOs):

1. **Understand, define** and **explain** the tools in recombinant DNA technology.
2. **Understand** techniques in recombinant DNA technology.
3. **Identify**, **select** and **implement** the PCR and its types in molecular biology and recombinant DNA technology.
4. **Understand and analyze** knowledge of mutagenesis.
5. **Apply** knowledge of genetic engineering in current applications of biotechnology.
6. **Comprehend** and **analyze** the impact of Human Genome Project in genetic engineering programme.

Text/References:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Ausubel et al (2002). Short Protocols in Molecular Biology. Wiley

7. Robertson et al (1997). Manipulation & Expression of Recombinant DNA. AP.

Online links for study & reference materials:

https://www.sciencedirect.com/topics/neuroscience/genetic-engineering

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BPE32

Course Name: Applied Food biotechnology

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

This course aims to impart a strong basic knowledge on processing criteria of foods (both traditional and emerging technologies) concepts applied in food processing industries, delivery of finished food products. Microbial safety, regulations in practice, traceability methods and state- of- the art analytical techniques used for assessing contamination of food

Course Description:

Technology of manipulating or modifying DNA for the purpose of improving the quality and or safety of **foods** - Use of genetics to improve plants animals and microorganisms for **food** production.

Course Contents:

UNIT I

Food Biotechnology: Introduction & Applications; Methods for the microbiological examination of water and foods; Control of Microbiological quality and safety; Food borne illnesses and diseases; Microbial cultures for food fermentation, their maintenance, strain development

UNIT II

Starter cultures–types, designing and development, micro encapsulation and packaging, scopes and challenge; Development and formulation of novel products such as probiotic foods. Nutrogenomics-concept, working, significance and relevance. Biosensors and novel tools and their application in food science & Technology

UNIT III

GM foods: Introduction and controversies related to GMOs. Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labelling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods. IPR. GMO Act–2004. New products and processes in various food commodities including plant and animal products.

UNIT IV

Production of organic acids (vinegar, lactic acid), alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka), glycerol; Propagation of baker's yeasts;

UNIT V

Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms

Course Learning Outcomes(CLOs):

Students will be able:

1. acquire an understanding of relevance of food components,
2. acquire an understanding application and detection techniques in food.
3. apply regulatory techniques in real time scenarios
4. acquire an understanding in industrial operations in food, role of microbes

Text/References:

1. Industrial Microbiology Prescott & Dunn, CBS Publishers
2. Modern Food Microbiology by Jay JM, CBS Publishers
3. Comprehensive Biotechnology by Murray & Mooyoung, Academic press
4. Industrial Microbiology by Casida L.R., New Age International Pvt. Ltd.
5. Food Microbiology; Frazier WC; 4th ed, Tata-McGrowhill Pub.
6. Microbiology by Pelczar, Chan, and Krieg, TMH
7. Fermentation Biotechnology, Principles, Processed Products by Ward OP, Open University Press.

Online links for study & reference materials:

https://www.brainkart.com/article/Food-biotechnology_33990/

Assessment method :

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**-40%**

Course Code: BPE33

Course Name: Molecular Modeling and Application

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

The objective of the course is to enable the students to understand basic modelling techniques to explore biological phenomena at the molecular level. To emphasize Modelling drug/receptor interactions in detail by molecular mechanics, molecular dynamics simulations and homology modelling.

Course Description:

Molecular modeling tools are used in drug discovery and materials design, and how you can incorporate these tools into research projects. In addition to utilizing modern techniques such as active learning and multimodal teaching, these courses will also provide a chance to work hands-on with Schrödinger software.

Course Contents:

UNIT I

Molecular Modelling: Introduction; Useful Concepts in Molecular Modelling; The Molecular Modelling Literature; Molecular Modelling software: BIOSUITE; Force Fields

UNIT II

Energy Minimisation and Computer Simulation: Minimisation and Related Methods for Exploring the Energy Surface. Non-Derivative method, 1st and 2nd order minimisation methods. Results of a Simulation and Estimating Errors. GROMACS and CNS. Molecular Dynamics & Monte Carlo Simulation;

UNIT III

Drugs: An introduction, Overview of drug discovery process, Trends in drug discovery process. Rationale of Drug Discovery: Medical needs, Target identification, Target validation, Receptors and assay development.

UNIT IV

Herbal Drugs: Definition, Trade scenario, Phytochemical standardization and fingerprinting, Marker compounds, Polyherbal formulations. Drug Development and Pre-Clinical Studies: Drug receptor interactions; enzyme inhibition and inactivation, In-vitro and in-vivo pharmacodynamic models, Therapeutic index, Pharmacokinetics - Microbial and animal models, In-vitro and insilico toxicological models, Drug formulations.

UNIT V

Applications of microbes for designing vaccines: case study.

Course Learning Outcomes (CLOs):

Students will be able:

1. Implement the principles and practice of modern drug discovery
2. Carry out molecular modelling principles and practice of molecular modelling
3. Use the concepts of rational drug design by understanding the three-dimensional structures and physicochemical properties of drugs and receptors.

Text/References:

1. Patwardhan B, Drug Discovery and Development - Traditional Medicine and Ethnopharmacology, New India Publishing (2007).
2. Larsen PK, Leljifore T and Medsan U, Text Book of Drug Design and Discovery, CRC Press (2009).
3. Hillisch A and Hilgenfeld R, Modern Methods of Drug Discovery, Birkhauser (2003).

Online links for study & reference materials:

http://www.drugdiscoverytoday.com/view/25419/molecular-modeling/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**-40%**

Course Code: BPE41 **Course Name:** Bioreactor Analysis and Design

Course Credit Hour: 3hr **Total Contact Hour:** 30hr

CourseObjective:

The course introduces the student to design principles of batch, fed-batch and continuous bioreactors. Mass and heat transfer requirements for a given fermentation system will be discussed. The student will also be able to identify suitable criterion for the scale-up of bioprocesses and characterize non-ideality in bioreactors, if present

Course Description:

A bioreactor provides a controllable environment enabling the biological, biochemical and biomechanical requirements to manufacture engineered product. As the bioreactor aims to create a desired biological product, it is important to closely monitor the reaction parameters like internal and external mass transfer, heat transfer, fluid velocity, shear stress etc

Course Contents:

UNIT I

Introduction; General design information; Material and energy balance calculations; Process Flow sheeting, Selection of bioprocess equipment (upstream and downstream); Specifications of bioprocess equipment; Mechanical design of reactors, heat transfer and mass transfer equipment; Design considerations for maintaining sterility of process streams and process equipment; Piping and instrumentation; Materials of construction for bioprocess plants.

UNIT I

Basic aspects of bioreactor designing, Physical, chemical and biological sensors and control, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and Artificial Neural Network (ANN) based controllers, Basic concepts of computer modelling and optimization in bioprocess applications.

UNIT III

Ideal bioreactors: Batch reactors, Fed-batch reactors, enzyme-catalyzed reaction in CSTRs, CSTR reactors with recycle and wall cell growth, the ideal plug-flow tubular reactor, Reactors with nonideal mixing: Mixing times in agitated tanks, residence time distribution, models for nonideal reactors, Mixing-bioreaction interactions.

UNIT IV

Reactor dynamics and stability, Multiphase bioreactors: conversion of heterogeneous substrates, packed-bed reactors, bubble column bioreactors, fluidized bed bioreactors, trickle-bed reactors, airlift reactor, Immobilized

Enzyme reactors, Photo bioreactors, Hollow fiber membrane bioreactors. Scale up and scale down issues: Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development, nutrient availability and supply; Bioreactor scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear), mass transfer coefficients.

UNIT V

Facility design aspects; Utility supply aspects; Equipment cleaning aspects; Culture cell banks; cGMP guidelines; Validation; Safety. Process economics; Case studies, Scale up of downstream processes: Adsorption (LUB method); Chromatography (constant resolution etc.); Filtration (constant resistance etc.); Centrifugation (equivalent times etc.); Extractors (geometry based rules).

Course Learning Outcomes (CLOs):

1. **Understand, define** and **explain** the types of bioreactors
2. **Understand** techniques for bioreactor design.
3. **implement** the Chromatography filtration centrifugation techniques in biotech industries.
4. **Handling of bioreactor equipment's.**
5. **Apply** knowledge of bioreactors tools in current biotechnological industries.

Text Books:

1. Moser, Anton, Bioprocess Technology: Kinetics and Reactors, Springer Verlag, 1988.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd ed., McGraw Hill, 1986
3. Lee, James M. Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors, Blanch, H.W. Clark, D.S. Biochemical Engineering, Marcel Decker, 1999
5. Biochemical Engineering fundamentals" 2nd ed. -J E Bailey and D F Ollis, McGraw-Hill (1986) Chapters 8,9&10.
6. Biochemical Engineering" -S Aiba, A E Humphrey and N Millis, 1978, University of Tokyo Press.
7. Biotechnology" Vols. 3 & 4 Eds., S Rehm and G Reed. VCH (1991).
8. Biochemical Engineering and Biotechnology Handbook" 2nd Ed., .Atkinson & F.Mavituna, Stockton Press (1991).
9. Biorector Design & Product Yield" , BIOTOL series, Butterworth - Heinemann (1992).
10. Principles of fermentation technology" - F Stanbury and A Whitaker, Pergamon press (1984) Unit operations of Chemical Engineering" 5th ed. by W L McCabe, J C Smith and P. Harriot Mc Graw-Hill (1993).
11. Bioprocess Engineering Principles" by Pauline M.Doran, Academic Press.

12. Feedback and Control systems- Schaum's outline series, McGraw-Hill Book Comp., 1967
13. Unit Operations of Chemical Engineering- Mc Caba Smith, Harriott, Mc Graw – Hill Chemical Engg. Series. V Ed., 1985.

Online links for study & reference materials:

https://www.classcentral.com/course/swayam-bioreactor-design-and-analysis-22924

Assessment method:

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BPE 42 **Course Name:** Enzyme Technology & Industrial Application

Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

The objective of the course is to inform the students about basic principles for optimization, modelling *etc* in which both, free and immobilized enzymes play a role. Students will be able to implement both biochemical and engineering knowledge in order to design new and improve current enzymatic processes.

Course Description:

The **enzyme** is a substance that acts as a catalyst in living organisms, regulating the rate at which chemical reactions proceed without itself being altered in the process. The study of industrial enzymes and their uses is called enzyme technology.

Course Content:

UNIT I-ENZYME TECHNOLOGY

Introductions: Enzymes- Michaelis-Menten kinetics. Kinetics and StatisticsInhibition- Effect of pH and temperature-Enzymology- Immobilized enzymes: Methods, Mass transfer considerations and Industrial enzymes.

UNIT II-METABOLISM, STOICHIOMETRY AND MICROBIAL GROWTH KINETICS

Introduction to metabolism- Nutrient transport- Glycolysis - TCA cycle and other pathways - Control of metabolism. Factors affecting microbial growth – Stoichiometry- mass balances and energy balances. Growth kinetics Measurement of growth.

UNIT III-BIOREACTORS, STERILIZATION, SENSORS AND INSTRUMENTATION

Introduction to bioreactors - Batch and Fed-batch bioreactors, Continuous bioreactors,Immoblized cells. Bioreactor operation, Sterilization, Aeration, Sensors. Instrumentation, Culture – specific design aspects: plant/mammalian cell culture reactors.

UNIT IV-PRIMARY & SECONDARY SEPARATION PROCESS

Biomass removal - Biomass disruption – Membrane based techniques. Extraction -solvent, aqueous two phases, super critical, and Adsorption. Chromatography, Precipitation (Ammonium Sulfate, solvent), Electrophoresis (capillary), Crystallization, Drying and Freeze drying.

UNIT V- INDUSTRIAL APPLICATION

White Biotechnology: Few industrial process using enzymes for production of drugs and fine chemicals, Enzyme based biosensors, Enzyme in organic catalysis, Molecular Imprinting. Enzyme engineering, selection of chiral molecules and their enzymatic separation, functional expression of enzymes protein engineering by modification of protein folding invitro and invivo, Case study.

Course Learning Outcomes(CLOs) :

Students will be able to:

1. Produce, isolate and purify enzymes at lab/industry scale
2. Apply reaction parameters and systems in order to develop an efficient enzymatic process.
3. Apply the biochemical knowledge to specific enzymatic process, 4. Predict the course of an enzymatic process by kinetic calculation

   5. Design new enzymatic processes

REFERENCES

1. Michael Shuler and FikretKargi. "Bioprocess Engineering: Basic Concepts", 2nd Edition, Prentice Hall, and Englewood Cliffs, NJ, 2002.
2. Pauline Doran. "Bioprocess engineering principles", Academic Press, 1995.
3. Colin Ratledge, Bjorn Kristiansen, "Basic Biotechnology", 2nd Edition, Cambridge University Press, 2001.
4. Roger Harrison et al., "Bioseparation Science and Engineering", Oxford University Press, 2003.

Online links for study & reference materials:

https://microbenotes.com/enzyme technology/

Assessment method:

(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: BPE 51

Course Name: Tissue Culture Techniques

Course Credit Hour: 3hr

Total Contact Hour: 30hr

Course Objective:

To make the students aware of the principles, practices and application of the plant tissue culture. Students acquire the necessary theoretical skills on animal tissue culture perspective. First, it provides detailed insights regarding the isolation of animal cells for *in vitro* studies, maintenance of animal cells *in vitro*, manipulation of animal cells *in vitro*, application of molecular techniques to *in vitro* situations. Furthermore the students will acquire knowledge in areas of cloning, large animal models for disease and development of therapies and treatments

Course Description:

Tissue culture (TC) is the cultivation of plant cells, tissues, or organs on specially formulated nutrient media. Under the right conditions, an entire plant can be regenerated from a single cell. Plant tissue culture is a technique that has been around for more than 30 years. Tissue culture is seen as an important technology for developing countries for the production of disease-free, high quality planting material and the rapid production of many uniform plants.

Course Content:

UNIT I

Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements.

UNIT II

Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines.

UNIT III

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for *in vitro* testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT IV

Fundamentals of plant tissue culture, plant regeneration: organogenesis. Somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Cell/callus line selection for resistance to herbicide, stress and diseases.: Isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids., Field techniques for propagation of regenerated plants.

UNIT V

Explant selection, sterilization and inoculation; Various media preparations; MS, B5, SH PC L- 2; Callus and cell suspension culture; Induction and growth parameters; Chromosomal variability in callus culture. Plant regeneration from embryo, meristem and callus culture. Androgenesis: Anther and pollen culture; Isolation and culture of protoplasts.

Course Learning Outcomes (CLOs):

Students will be able to:

1. **Understand** the **use** of different plant tissue culture (PTC) techniques for PTC Industries as well as research.
2. **Explain** the various components of cell and tissue culture media as well as establishment and optimization of media for particular purposes in different species and cell lines.

Texts/References:

1. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell, 2000
2. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
3. I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International, 2003.

Online links for study & reference materials:

https://www.isaaa.org/resources/publications/pocketk/14/default.asp

Assessment method:

(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%

Course Code: BPE53

Course Name: Fundamentals of Stem Cell Technology

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

The objective of this course is to enable students to understand the principles of stem cells. To acquire knowledge in the areas of tissue engineering.

Course Description:

Stem cells are the **foundation cells** for every organ, tissue and **cell** in the body. ... Under proper conditions, **stem cells** begin to develop into specialized tissues and organs. Additionally, **stem cells** can self-renew, that is they can divide and give rise to more **stem cells**

Course Contents:

UNIT –I

Cell Diversification in Early Animal Embryo:

Process of fertilization & stages of development in Eukaryotes, pluripotency & formation of three germ layers, Differentiation, Organogenesis, ICM, cellular mechanism relating to these developments.

UNIT –II

Stem cell differentiation:

The process of stem cell differentiation leading to the formation of epidermal cells, skeletal muscles. Transformation of stem cell into gametes/ fertilization entity, Spermatogenesis & oogenesis. Menstrual Cycle.

UNIT-III

Hemopoietic Stem Cells:

Classification and manifestation of Hemopoietic stem cell disorders, plastic hemopoietic stem cell disorders, myelo dysplastic, myelo proliferative disorders, complications involved in gene therapy, blood transfusion & marrow transplantations, preservation & clinical use of blood, hemapheresis & Apheresis procedures,

UNIT-IV

Concept of stem cells & their applications:

Stem cells & their unique properties, Embryonic stem cells, Adult stem cells, induced pluripotent stem cells, epidermal stem cells & their applications hepatic stem cells & their role in liver regeneration, stem cell treatments, ethical issues of stem cell research.

UNIT-V

Stem cell therapy:

Potential of stem cell therapy for various diseases, eg. AIDS/HIV, Alzhemier's disease, Anaemia, Anti-ageing, Multiple sclerosis, Parkinson disease, Rheumatoid Arthritis.

Course Learning Outcomes (CLOs)

The students will be able

1. Describe the design, fabrication and biomaterials selection criteria for tissue engineering scaffolds.
2. Discuss the challenges of in vivo implantation of biomaterials and scale-up issues relating to human clinical applications
3. Describe the sources, selection, potential manipulations and challenges of using stem cells for tissue engineering.

   Explain the ethical and regulatory issues of significance in tissue engineering

References:

1. Essential Cell Biology, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Kieth Roberts and Jamnes D. Watson, Garland Science, Taylor and Francis Group, 2nd Edition, 2003.
2. Stem Cell Biology by Marshak, Cold Spring Harbar Symposium Publication, 2001.
3. Molecular Biology of the Cell, Bruce Alberts, Dennis Bray, Alexander Johnson, Julian Lewis, Martin Raff, Kieth Roberts and Peter Walter, Garland Science, Taylor and Francis Group, 4th Edition, 2003.
4. Molecular and Cell Biology- Schaum's Outline of Theory and Problems by Willam D. Stansfield, Jaime S.Colorne and Raul J. Cano. Tata McGraw Hill Publisher, 2004.

Online links for study & reference materials :

https://www.unmc.edu/stemcells/stemcells/basics.html#:~:text=Stem%20cells%20are%20the%20foundation,and%20cell%20in%20the%20body.&text=Under%20proper%20conditions%2C%20stem%20cells,rise%20to%20more%20stem%20cells.

Assessment method:

(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

BPCL3: BIOINFORMATICS LAB

1. To find out five similar sequences of any Protein and DNA query sequence.
2. To predict open reading frame of any given gene sequence.
3. To perform pair wise local and global sequence alignment for any two proteins and DNA sequences.
4. To perform multiple sequence alignment for any five sequences and predicts the Phylogenetic relationship among them.
5. To predict secondary structure for any given protein sequence using Chou-Fasman, GOR and Neural network algorithms.
7. To visualize tertiary structure of any given protein sequence using Rasmol/PyMol/PMV.
8. To visualize the genomic map of Human genome and find out the size, number of genes and number of proteins encoded on Chr-Y.
9. To predict the homology model of any protein sequence.
10. To find out the RMSD value from any two protein structure alignment.

BPCL4: RECOMBINANT DNA TECHNOLOGY LAB

1. Genomic DNA Isolation
2. Designing of Primers
3. Gel electrophoresis of nucleic acids
4. Optimization of Gel PCR
5. Digestion and Elution of PCR products and Expression vector with respective Restriction Enzyme.
6. Ligation of PCR Product with expression vector
7. Transformation of competent cells with plasmid DNA
8. Screening of Colony PCR
9. Growth Assay in broth/Plate

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Digital Communcation

Program Outcomes (POs)

Students will be able to

1. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like optical communication, satellite communication, wireless communication, networking, RF-microwave, antennas, measurements and standards in communication.

3. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

4. Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
DPCT1	Advanced Communication Networks	3	0	0	40	60	100	3
DPCT2	Wireless and Mobile Communication	3	0	0	40	60	100	3
DPE1x	Program Elective-1 (1) Wireless Sensor Networks (2) Optical Networks (3) Statistical Information Processing	3	0	0	40	60	100	3
DPE2x	Program Elective-2 (1) Cognitive Radio (2) RF and Microwave Circuit Design (3) DSP Architecture	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
DPCL1	Advanced Communication Networks Lab	0	0	4	40	60	100	2
DPCL2	Wireless and Mobile Communication Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
DPCT3	Antenna & Radiating Systems	3	0	0	40	60	100	3
DPCT4	Advanced Digital Signal Processing	3	0	0	40	60	100	3
DPE3x	Program Elective-3 (1) Satellite Communication (2) Internet of Things (3) Voice and Data Networks	3	0	0	40	60	100	3
DPE4x	Program Elective-4 (1) Markov Chain and Queueing System (2) MIMO System (3) Programmable Networks – SDN, NFV	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
DPCL3	Antenna & Radiating Systems Lab	0	0	4	40	60	100	2
DPCL4	Advanced Digital Signal Processing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2
MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
DPE5x	Program Elective-5 (1) High Performance Networks (2) Pattern Recognition and Machine Learning (3) Remote Sensing	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective
MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

ADVNACED COMMUNICATION NETWORK

Course Code: DPCT1 **Credit: 03**

Unit 1: Overview of Internet-Concepts, challenges and history, overview of ATM, TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Unit 2: Real Time Communications over Internet, Adaptive applications, Latency and throughput issues, Integrated Services Model (intServ), Resource reservation in Internet, RSVP, Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

Unit 3: Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service Connections, GPS, WFQ and Rate proportional algorithms, High speed scheduler design, Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic, Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Unit 4: IP address lookup-challenges, Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Unit 5: Admission control in Internet, Concept of Effective bandwidth, Measurement based admission control, Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

Unit 6: IPV4, IPV6, IP tunnelling, IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching, MPLS architecture and framework, MPLS Protocols, Traffic engineering issues in MPLS.

References:

- Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2000.
- Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.
- Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
- Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
- George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

WIRELESS & MOBILE COMMUNICATION

Course Code: DPCT2 **Credit: 03**

Unit 1: Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Unit 2: Spectral efficiency analysis based on calculations for multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit 3: Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit 4: Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Unit 5: Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Unit 6: Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

References:

- V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
- V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
- T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI, 2002.
- William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
- Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Boston, London, 1997.

WIRELESS SENSOR NETWORK

Course Code: DPE11 **Credit: 03**

Unit 1: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Unit 2: Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 3: Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 4: Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 5: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 6: Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and enabling technologies in wireless sensor network.

References:

- H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
- F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
- YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

OPTICAL NETWORKS

Course Code: DPE12 **Credit: 03**

Unit 1: SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.

Unit 2: WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Unit 3: Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Unit 4: Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 5: WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Unit 6: Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

References:

- Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
- C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.

STATISTICAL INFORMATION PROCESSING

Course Code: DPE13 **Credit: 03**

Unit 1: Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit 2: Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit 3: Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Unit 4: Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Unit 5: Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit 6: Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

References:

- Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
- Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
- Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

COGNITIVE RADIO

Course Code: DPE21 **Credit: 03**

Unit 1: Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Unit 2: Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Unit 3: Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Unit 4: Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Unit 5: Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Unit 6: Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

References:

- Ekram Hossain, Dusit Niyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press, 2009.
- Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd., 2009.
- Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition, 2009.
- Huseyin Arslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007.
- Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer, 2009.
- Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press, 2009.

RF & MICROWAVE CIRCUIT DESIGN

Course Code: DPE22 **Credit: 03**

Unit 1: Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Unit 2: Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Unit 3: Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Unit 4: Nonlinearity and Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Unit 5: Microwave Semiconductor Devices and Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Unit 6: Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.

References:

- Matthew M. Radmanesh, “Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design”, Author House, 2009.
- D.M.Pozar, “ Microwave engineering” ,Wiley, 4th edition, 2011.
- R.Ludwig and P.Bretchko, “R. F. Circuit Design”, Pearson Education Inc, 2009.
- G.D. Vendelin, A.M. Pavoi, U. L. Rohde, “Microwave Circuit Design Using Linear and Non Linear Techniques”, John Wiley 1990.
- S.Y. Liao, “Microwave circuit Analysis and Amplifier Design”, Prentice Hall 1987.
- Radmanesh, “RF and Microwave Electronics Illustrated” , Pearson Education, 2004.

DSP ARCHITECTURE

Course Code: DPE23 **Credit: 03**

Unit 1: Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2: Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Unit 3: VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Unit 4: Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming – OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

Unit 5: FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.

Unit 6: High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

- M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
- Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011
- Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,“Parallel Programming in OpenMP”, 1st Edition, Morgan Kaufman, 2000.
- Ann Melnichuk, Long Talk, “Multicore Embedded systems”, 1st Edition, CRC Press,2010.
- Wayne Wolf, “High Performance Embedded Computing: Architectures, Applications and Methodologies”, 1st Edition, Morgan Kaufman, 2006.
- E. S. Gopi, “Algorithmic Collections for Digital Signal Processing Applications Using MATLAB”, 1st Edition, Springer Netherlands, 2007.

ADVANCED COMMUNICATION NETWORKS LAB

Course Code: DPCL1 **Credit: 02**

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
   a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

WIRELESS AND MOBILE COMMUNICATION LAB

Course Code: DPCL2 **Credit: 02**

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.

2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.

3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.

5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.

6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.

7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.

8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

ANTENNAS AND RADIATING SYSTEMS

Course Code: DPCT3 **Credit: 03**

Unit 1: Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Unit 2: Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Unit 3: Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Unit 4: Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Unit 5: Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Unit 6: Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

References:

- Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
- John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
- R. C. Johnson and H. Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
- I. J. Bhal and P. Bhartia, "Micro-strip antennas", Artech house, 1980.

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code: DPCT4 **Credit: 03**

Unit 1: Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.

Unit 2: Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.

Unit 3: Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4: Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm.

Unit 5: Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Unit6: Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References:

- J. G. Proakis and D. G. Manolakis, “Digital signal processing: Principles, Algorithm & Applications”, 4th Edition, Prentice Hall, 2007.
- N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems -Filter Banks –Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.
- Bruce W. Suter, “Multirate and Wavelet Signal Processing”,1st Edition, Academic Press, 1997.
- M. H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons Inc., 2002.
- S. Haykin, “Adaptive Filter Theory”, 4th Edition, Prentice Hall, 2001.
- D. G. Manolakis, V.K. Ingle and S.M.Kogon, “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000

SATELLITE COMMUNICATION

Course Code: DPE31 **Credit: 03**

Unit 1: Architecture of Satellite Communication System: Principles and architecture of satellite communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Unit 2: Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Unit 3: Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Unit 4: Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit 5: Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Unit 6: Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ISRO, GPS.

References:

- Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010.
- S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
- Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
- Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

INTERNET OF THINGS

Course Code: DPE32 **Credit: 03**

Unit 1: Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.

Unit 2: Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.

Unit 3: Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.

Unit 4: Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.

Unit 5: Operating systems requirement of IoT environment, study of mbed, RIoT, Contiki operating systems, introductory concepts of big data for IoT applications.

Unit 6: Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.

References:

- A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, VPT publisher, 2014.
- A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.
- CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011.
- Samuel Greenguard, “Internet of things”, MIT Press, 2015.

VOICE AND DATA NETWORKS

Course Code: DPE33 **Credit: 03**

Unit 1: Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Unit 2: Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Unit 3: Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission, Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Unit 4: Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks

Unit 5: Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet, End to End Protocols, TCP and UDP, Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Unit 6: Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

References:

- D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.
- L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufman, 2011.
- Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.
- Walrand, “Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.
- Leonard Kleinrock, “Queueing Systems, Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.
- Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.
- Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987.

MARKOV CHAINS AND QUEUEING SYSTEMS

Course Code: DPE41 **Credit: 03**

Unit 1: Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.

Unit 2: Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.

Unit 3: Discrete time Markov chains: definitions and properties, matrix representation, Perron-Frobenius theory.

Unit 4: Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death processes, Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.

Unit 5: Fundamental queuing results: Little's theorem, invariance of the mean delay, Conservation law. Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.

Unit 6: Advanced queuing models: priority, vacation and retrials in queues.

References:

- Cliffs, “Stochastic Modelling and the Theory Queues”, Prentice Hall, 1989.
- P.Bremaud, “Markov Chains”, Springer-Verlag, 1999.
- E.Seneta, “Non Negative Matrices and Markov Chains”, Springer Series in Statistics,
- Springer,1981.
- R.Gallager, “Discrete Stochastic Processes”, Kluwer Academic Press, 1996.
- L.Kleinrock, “Queuing Systems”, vols I and II, John Wiley and Sons 1976.

MIMO SYSTEMS

Course Code: DPE42 **Credit: 03**

Unit 1: Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Unit 2: Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

Unit 3: The generic MIMO problem, Singular Value Decomposition, Eigen values and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

Unit 4: Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer.

Unit 5: Case study: MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.

Unit 6: Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References:

- Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
- Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

PROGRAMMABLE NETWORKS - SDN, NFV

Course Code: DPE43 **Credit: 03**

Unit 1: Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.

Unit 2: Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

Unit 3: Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

Unit 4: Control Plane: Overview, Existing SDN Controllers including Floodlight and OpenDaylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hadrware-based; Programmable Network Hardware.

Unit 5: Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

Unit 6: Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

References:

- Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, O'Reilly Media, August 2013.
- Paul Goransson, Chuck Black, Timothy Culver. “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann Publishers, 2016.
- Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, 2014.
- Nick Feamster, Jennifer Rexford and Ellen Zegura, “The Road to SDN: An Intellectual History of Programmable Networks” ACM CCR April 2014.

ANTENNAS AND RADIATING SYSTEMS LAB

Course Code: DPCL3 **Credit: 02**

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.

ADVANCED DIGITAL SIGNAL PROCESSING LAB

Course Code: DPCL4 **Credit: 02**

1. Basic Signal Representation
2. Correlation Auto and Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT of Input Sequence
5. Butterworth Low pass and High pass Filter Design
6. Chebychev Type I, II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation and Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution and M Fold Decimation &PSD Estimator
13. Estimation of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation of T/F
17. Parallel Realization of IIR filter

HIGH PERFORMANCE NETWORKS

Course Code: DPE51 **Credit: 03**

Unit 1: Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture, Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2: VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks, Providing IP quality of service for voice, signalling protocols for VoIP, PSTN gateways, VoIP applications.

Unit 3: VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Unit 4: Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Unit 5: Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

Unit 6: Infrastructure for network management, internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.

References:

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
- Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
- Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
- Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
- Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
- Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.
- William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

PATTERN RECOGNITION AND MACHINE LEARNING

Course Code: DPE52 **Credit: 03**

Unit 1

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error Analysis

Unit 2

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

Unit 3

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4

Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5

Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unit 6

Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

References:

- Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.
- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
- C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

REMOTE SENSING

Course Code: DPE53 **Credit: 03**

Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned spacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film -Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification– Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

- Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6thEdition
- John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
- John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis, 1999.
- Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
- Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
- Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W. H. Freeman & Co, 1978.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

VLSI Technology

Program Outcomes (POs)

Students will be able to

1. Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Identify, formulate and solve engineering problems in the broad areas like System Design using VLSI and Embedded Platforms and tools, Semiconductor Technologies, Applications in Signal Processing, Machine Vision and Communication Networks.

3. Use different software tools in the domain of VLSI and Embedded Systems Design, Analysis and Verification such as Design entry, Synthesis, Functional and Timing Simulation, Floor-planning, Place and route, Layout editors, RTL schematic, Platform specific EDA sets, MATLAB.

4. Design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
VPCT1	RTL Simulation and Synthesis with PLDs	3	0	0	40	60	100	3
VPCT2	Microcontrollers and Programmable Digital Signal Processors	3	0	0	40	60	100	3
VPE1x	Program Elective-1 (1) Digital Signal and Image Processing (2) Programming Languages for Embedded Software (3) VLSI signal processing	3	0	0	40	60	100	3
VPE2x	Program Elective-2 (1) Parallel Processing (2) System Design with Embedded Linux (3) CAD of Digital System	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
VPCL1	RTL Simulation and Synthesis with PLDs Lab	0	0	4	40	60	100	2
VPCL2	Microcontrollers and Programmable Digital Signal Processors Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
VPCT3	Analog and Digital CMOS VLSI Design	3	0	0	40	60	100	3
VPCT4	VLSI Design Verification and Testing	3	0	0	40	60	100	3
VPE3x	Program Elective-3 (1) Memory Technologies (2) SoC Design (3) Low power VLSI Design	3	0	0	40	60	100	3
VPE4x	Program Elective-4 (1) Communication Buses and Interfaces (2) Network Security and Cryptography (3) Physical design automation	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
VPCL3	Analog and Digital CMOS VLSI Design Lab	0	0	4	40	60	100	2
VPCL4	VLSI Design Verification and Testing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2
MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
VPE5x	Program Elective-5 (1) Communication Network (2) Selected Topics in Mathematics (3) Nano materials and Nanotechnology	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

RTL Simulation and Synthesis with PLDs

Teaching Scheme **Paper Code: VPCT1**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Familiarity of Finite State Machines, RTL design using reconfigurable logic.
- Design and develop IP cores and Prototypes with performance guarantees
- Use EDA tools like Cadence, Mentor Graphics and Xilinx.

Syllabus Contents:

Unit1: Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.

Unit 2: Design entry by Verilog/VHDL/FSM, Verilog AMS.

Unit 3: Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.

Unit 4: Design for performance, Low power VLSI design techniques. Design for testability.

Unit 5: IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping

Unit 6: Case studies and Speed issues.

References:

1. Richard S. Sandige, “Modern Digital Design”, MGH, International Editions.
2. Donald D Givone, “Digital principles and Design”, TMH
3. Charles Roth, Jr. and Lizy K John, “Digital System Design using VHDL”, Cengage Learning.
4. Samir Palnitkar, “Verilog HDL, a guide to digital design and synthesis”, Prentice Hall.
5. Doug Amos, Austin Lesea, Rene Richter, “FPGA based prototyping methodology manual”, Xilinx
6. Bob Zeidman, “Designing with FPGAs & CPLDs”, CMP Books.

Microcontrollers and Programmable Digital Signal Processors

Teaching Scheme **Paper Code: VPCT2**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Compare and select ARM processor core based SoC with several features/peripherals based on requirements of embedded applications.
- Identify and characterize architecture of Programmable DSP Processors
- Develop small applications by utilizing the ARM processor core and DSP processor based platform.

Syllabus Contents:

Unit 1: ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces

Unit 2: Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

Unit 3: LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT

Unit 4: Programmable DSP (P-DSP) Processors: Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family

Unit 5: VLIW architecture and TMS320C6000 series, architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations

Unit 6: Code Composer Studio for application development for digital signal processing, On chip peripherals, Processor benchmarking

References:

1. Joseph Yiu, “The definitive guide to ARM Cortex-M3”, Elsevier, 2nd Edition
2. Venkatramani B. and Bhaskar M. “Digital Signal Processors: Architecture, Programming and Applications” , TMH , 2nd Edition
3. Sloss Andrew N, Symes Dominic, Wright Chris, “ARM System Developer's Guide: Designing and Optimizing”, Morgan Kaufman Publication
4. Steve furber, “ARM System-on-Chip Architecture”, Pearson Education
5. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley
6. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

Elective I

Digital Signal and Image Processing

Teaching Scheme **Paper Code: VPE11**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Analyze discrete-time signals and systems in various domains
- Design and implement filters using fixed point arithmetic targeted for embedded platforms
- Compare algorithmic and computational complexities in processing and coding digital images.

Syllabus Contents:

Unit 1: Review of Discrete Time signals and systems, Characterization in time and Z and Fourier – domain, Fast Fourier Transform algorithms – In-place computations, Butterfly computations, bit reversal's.

Unit 2: Digital Filter design: FIR - Windowing and Frequency Sampling, IIR – Impulse invariance, bilinear Transformation.

Unit 3: Fixed point implementation of filters – challenges and techniques.

Unit 4: Digital Image Acquisition, Enhancement, Restoration. Digital Image Coding and Compression – JPEG and JPEG 2000.

Unit 5: Color Image processing – Handling multiple planes, computational challenges.

Unit 6: VLSI architectures for implementation of Image Processing algorithms, Pipelining.

References:

1. J.G. Proakis, Manolakis "Digital Signal Processing", Pearson, 4th Edition
2. Gonzalez and Woods, "Digital Image Processing", PHI, 3rd Edition
3. S. K. Mitra. "Digital Signal Processing – A Computer based Approach", TMH, 3rd Edition, 2006
4. A. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall
5. KeshabParhi, "VLSI Digital Signal Processing Systems – Design and Implementation", Wiley India

Elective I

Programming Languages for Embedded Software

Teaching Scheme **Paper Code: VPE12**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Write an embedded C application of moderate complexity.
- Develop and analyze algorithms in C++.
- Differentiate interpreted languages from compiled languages.

Syllabus Contents:

Unit 1: Embedded 'C' Programming:

- Bitwise operations, Dynamic memory allocation, OS services
- Linked stack and queue, Sparse matrices, Binary tree
- Interrupt handling in C, Code optimization issues
- Writing LCD drives, LED drivers, Drivers for serial port communication
- Embedded Software Development Cycle and Methods (Waterfall, Agile)

Unit 2: Object Oriented Programming:

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data abstraction and information hiding, inheritance, polymorphism

Unit 3: CPP Programming: 'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation

Unit 4: Overloading and Inheritance: Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance, virtual base class, polymorphism, virtual functions,

Unit 5: Templates: Function template and class template, member function templates and template arguments,Exception Handling: syntax for exception handling code: try-catch-throw, Multiple Exceptions.

Unit 6: Scripting Languages: Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

References:

1. Michael J. Pont , "Embedded C", Pearson Education, 2nd Edition, 2008
2. Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6th Edition 2011
3. A. Michael Berman, "Data structures via C++", Oxford University Press, 2002
4. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999
5. Abraham Silberschatz, Peter B, Greg Gagne, "Operating System Concepts", John Willey & Sons, 2005

Elective I

VLSI Signal Processing

Teaching Scheme **Paper Code: VPE13**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Acquired knowledge about DSP algorithms, its DFG representation, pipelining and parallel processing approaches.
- Ability to acquire knowledge about retiming techniques, folding and register minimization path problems.
- Ability to have knowledge about algorithmic strength reduction techniques and parallel processing of FIR and IIR digital filters.
- Acquired knowledge about finite word-length effects and round off noise computation in DSP systems.

Syllabus Contents:

Unit 1: Introduction to DSP systems, Pipelined and parallel processing.

Unit 2: Iteration Bound, Retiming, unfolding, algorithmic strength reduction in filters and Transforms.

Unit 3: Systolic architecture design, fast convolution, pipelined and parallel recursive and adaptive filters, Scaling and round off noise.

Unit 4: Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic.

Unit 5: Numerical strength reduction, synchronous, wave and asynchronous pipe lines, low power design.

Unit 6: Programmable digit signal processors.

References:

1. Keshab K. Parthi[A1] , VLSI Digital signal processing systems, design and implementation[A2] , Wiley, Inter Science, 1999.
2. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994
3. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.

Elective II
Parallel Processing

Teaching Scheme **Paper Code: VPE21**
Lectures: 3hrs/week

Course Outcomes:
At the end of this course, students will be able to
- Identify limitations of different architectures of computer
- Analysis quantitatively the performance parameters for different architectures
- Investigate issues related to compilers and instruction set based on type of architectures.

Syllabus Contents:
Unit 1: Overview of Parallel Processing and Pipelining, Performance analysis, Scalability
Unit 2: Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining
Unit 3: VLIW processors, Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture
Unit 4: Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions
Unit 5: Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues
Unit 6: Operating systems for multiprocessors systems customizing applications on parallel processing platforms

References:

1. Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing”, MGH International Edition
2. Kai Hwang, “Advanced Computer Architecture”, TMH
3. V. Rajaraman, L. Sivaram Murthy, “Parallel Computers”, PHI.
4. William Stallings, “Computer Organization and Architecture, Designing for performance” Prentice Hall, Sixth edition
5. Kai Hwang, Zhiwei Xu, “Scalable Parallel Computing”, MGH
6. David Harris and Sarah Harris, “Digital Design and Computer Architecture”, Morgan Kaufmann.

Elective II

System Design with Embedded Linux

Teaching Scheme **Paper Code: VPE22**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Familiarity of the embedded Linux development model.
- Write, debug, and profile applications and drivers in embedded Linux.
- Understand and create Linux BSP for a hardware platform

Syllabus Contents:

Unit 1: Embedded Linux Vs Desktop Linux, Embedded Linux Distributions

Unit 2: Embedded Linux Architecture, Kernel Architecture – HAL, Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC, User space, Start-up sequence

Unit 3: Board Support Package

Embedded Storage: MTD, Architecture, Drivers, Embedded File System

Embedded Drivers: Serial, Ethernet, I_2C, USB, Timer, Kernel Modules

Unit 4: Porting Applications

Real-Time Linux: Linux and Real time, Programming, Hard Real-time Linux

Unit 5: Building and Debugging: Kernel, Root file system, Embedded Graphics

Unit 6: Case study of uClinux

References:

1. Karim Yaghmour, "Building Embededd Linux Systems", O'Reilly & Associates
2. P Raghvan, Amol Lad, SriramNeelakandan, "Embedded Linux System Design and Development", Auerbach Publications
3. Christopher Hallinan, "Embedded Linux Primer: A Practical Real World Approach", Prentice Hall, 2nd Edition, 2010.
4. Derek Molloy, "Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux", Wiley, 1st Edition, 2014.

Elective II
CAD of Digital System

Teaching Scheme **Paper Code: VPE23**
Lectures: 3 hrs/week

Course Outcomes:
At the end of this course, students will be able to
- Fundamentals of CAD tools for modelling, design, test and verification of VLSI systems.
- Study of various phases of CAD, including simulation, physical design, test and verification.
- Demonstrate knowledge of computational algorithms and tools for CAD.

Syllabus Contents:
Unit 1: Introduction to VLSI Methodologies – Design and Fabrication of VLSI Devices, Fabrication Process and its impact on Design.
Unit 2: VLSI design automation tools – Data structures and basic algorithms, graph theory and computational complexity, tractable and intractable problems.
Unit 3: General purpose methods for combinational optimization – partitioning, floor planning and pin assignment, placement, routing.
Unit 4: Simulation – logic synthesis, verification, high level Synthesis.
Unit 5 and 6: MCMS-VHDL-Verilog-implementation of simple circuits using VHDL

References:
1. N.A. Sherwani, “Algorithms for VLSI Physical Design Automation”.
2. S.H. Gerez, “Algorithms for VLSI Design Automation.

RTL Simulation and Synthesis with PLDs Lab

Teaching Scheme **Paper Code: VPCL1**

Lectures:4 hrs/week

Course Outcomes:

At the end of the laboratory work, students will be able to:

- Identify, formulate, solve and implement problems in signal processing, communication systems etc using RTL design tools.
- Use EDA tools like Cadence, Mentor Graphics and Xilinx.

List of Experiments:

1) Verilog implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator, Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, bidirectional), 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
2) Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
3) Vending machines - Traffic Light controller, ATM, elevator control.
4) PCI Bus & arbiter and downloading on FPGA.
5) UART/ USART implementation in Verilog.
6) Realization of single port SRAM in Verilog.
7) Verilog implementation of Arithmetic circuits like serial adder/ subtractor, parallel adder/subtractor, serial/parallel multiplier.
8) Discrete Fourier transform/Fast Fourier Transform algorithm in Verilog.

Microcontrollers and Programmable Digital Signal Processors Lab

Teaching Scheme **Paper Code: VPCL2**

Lectures: 4 hrs/week

Course Outcomes:

At the end of the laboratory work, students will be able to:

- Install, configure and utilize tool sets for developing applications based on ARM processor core SoC and DSP processor.
- Develop prototype codes using commonly available on and off chip peripherals on the Cortex M3 and DSP development boards.

List of Assignments:

Part A) Experiments to be carried out on Cortex-M3 development boards and using GNU tool chain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. Sample sound using a microphone and display sound levels on LEDs.

Part B) Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

1. To develop an assembly code and C code to compute Euclidian distance between any two points
2. To develop assembly code and study the impact of parallel, serial and mixed execution
3. To develop assembly and C code for implementation of convolution operation
4. To design and implement filters in C to enhance the features of given input sequence/signal

Analog and Digital CMOS VLSI Design

Teaching Scheme **Paper Code: VPCT3**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Analyze, design, optimize and simulate analog and digital circuits using CMOS constrained by the design metrics.
- Connect the individual gates to form the building blocks of a system.
- Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice.

Syllabus Contents:

Technology Scaling and Road map, Scaling issues, Standard 4 mask NMOS Fabrication process

Digital CMOS Design:

Unit 1: Review: Basic MOS structure and its static behavior, Quality metrics of a digital design: Cost, Functionality, Robustness, Power, and Delay, Stick diagram and Layout, Wire delay models.

Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation, Dynamic behavior, Power consumption.

Unit 2: Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model.

Combinational logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Unit 3: Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit.

Advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET etc.

Analog CMOS Design:

Unit 4: Single Stage Amplifier: CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common gate stage, Cascade stage, Choice of device models.

Differential Amplifiers: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Unit 5: Passive and active current mirrors: Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage and difference pair, Noise

Unit 6: Operational amplifiers: One stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP, Other compensation techniques.

References:

1. J P Rabaey, A P Chandrakasan, B Nikolic, “Digital Integrated circuits: A design perspective”, Prentice Hall electronics and VLSI series, 2nd Edition.
2. Baker, Li, Boyce, “CMOS Circuit Design, Layout, and Simulation”, Wiley, 2nd Edition.
3. Behzad Razavi , “Design of Analog CMOS Integrated Circuits”, TMH, 2007.
4. Phillip E. Allen and Douglas R. Holberg, “CMOS Analog Circuit Design”, Oxford, 3rd Edition.
5. R J Baker, “CMOS circuit Design, Layout and Simulation”, IEEE Inc., 2008.
6. Kang, S. and Leblebici, Y., “CMOS Digital Integrated Circuits, Analysis and Design”, TMH, 3rd Edition.
7. Pucknell, D.A. and Eshraghian, K., “Basic VLSI Design”, PHI, 3rd Edition.

VLSI Design Verification and Testing

Teaching Scheme **Paper Code: VPCT4**

Lectures: 3 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Familiarity of Front end design and verification techniques and create reusable test environments.
- Verify increasingly complex designs more efficiently and effectively.
- Use EDA tools like Cadence, Mentor Graphics.

Syllabus Contents:

Unit 1: Verification guidelines: Verification Process, Basic Testbench functionality, directed testing, Methodology basics, Constrained-Random stimulus, Functional coverage, Testbench components, Layered testbench, Building layered testbench, Simulation environment phases, Maximum code reuse, Testbench performance.

Unit 2: Data types: Built-in data types, Fixed-size arrays, Dynamic arrays, Queues, Associative arrays, Linked lists, Array methods, Choosing a storage type, Creating new types with typedef, Creating user-defined structures, Type conversion, Enumerated types, Constants strings, Expression width.

Unit 3: Procedural statements and routines: Procedural statements, tasks, functions and void functions, routine arguments, returning from a routine, local data storage, time values

Connecting the testbench and design: Separating the testbench and design, Interface constructs, Stimulus timing, Interface driving and sampling, Connecting it all together, Top-level scope Program – Module interactions.

Unit 4: SystemVerilog Assertions: Basic OOP: Introduction, think of nouns, Not verbs, your first class, where to define a class, OOP terminology, Creating new objects, Object de-allocation, Using objects, Static variables vs. Global variables, Class methods, Defining methods outside of the class, Scoping rules, Using one class inside another, Understanding dynamic objects, Copying objects, Public vs. Local, Straying off course building a testbench.

Unit 5: Randomization: Introduction, What to randomize, Randomization in System Verilog, Constraint details solution probabilities, Controlling multiple constraint blocks, Valid constraints, In-line constraints, The pre-randomize and post-randomize functions,

Unit 6: Random number functions, Constraints tips and techniques, Common randomization problems, Iterative and array constraints, Atomic stimulus generation vs. Scenario generation, Random control, Random number generators, Random device configuration.

References:

1. Chris Spears, " System Verilog for Verification", Springer, 2nd Edition
2. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers
3. IEEE 1800-2009 standard (IEEE Standard for System Verilog— Unified Hardware Design, Specification, and Verification Language).

4. System Verilog website – www.systemverilog.org
5. http://www.sunburstdesign.com/papers/CummingsSNUG2006Boston_SystemVerilog Events.pdf
6. General reuse information and resources www.design-reuse.com
7. OVM, UVM (on top of SV) www.verificationacademy.com
8. Verification IP resources
   http://www.cadence.com/products/fv/verification_ip/pages/default.aspx
   http://www.synopsys.com/Tools/Verification/FunctionalVerification/VerificationIP/Pages/default.aspx

Elective III
Memory Technologies

Teaching Scheme **Paper Code: VPE31**
Lectures: 3 hrs/week

Course Outcomes:
At the end of the course, students will be able to:
- Select architecture and design semiconductor memory circuits and subsystems.
- Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
- Knowhow of the state-of-the-art memory chip design

Syllabus Contents:
Unit 1: Random Access Memory Technologies:
Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.
Unit 2: DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs.SRAM and DRAM Memory controllers.
Unit 3: Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.
Unit 4: Semiconductor Memory Reliability and Radiation Effects: General Reliability Issues, RAM Failure Modes and Mechanism, Nonvolatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues, Radiation Hardened Memory Characteristics, Radiation Hardness Assurance and Testing.
Unit 5: Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices.
Unit 6: Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging

References:

1. Ashok K Sharma, “Advanced Semiconductor Memories: Architectures, Designs and Applications”, Wiley Interscience
2. Kiyoo Itoh, “VLSI memory chip design”, Springer International Edition
3. Ashok K Sharma,” Semiconductor Memories: Technology, Testing and Reliability, PHI

Elective III
SoC Design

Teaching Scheme **Paper Code: VPE32**
Lectures: 3 hrs/week

Course Outcomes:
At the end of the course, students will be able to:
- Identify and formulate a given problem in the framework of SoC based design approaches
- Design SoC based system for engineering applications
- Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

Syllabus Contents:
Unit 1: ASIC
Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.
Unit 2: NISC
NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set, Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.
Unit 3: Simulation
Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.
Unit 4: Low power SoC design / Digital system, Design synergy, Low power system perspective- power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.
Unit 5: Synthesis
Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysisSingle core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs
Unit 6: Case study for overview of cellular phone design with emphasis on area optimization, speed improvement and power minimization.

Note: Students will prepare and present a term paper on relevant identified current topics (in batches of three students per topic) as a part of theory course.

References:

1. Hubert Kaeslin, "Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication", Cambridge University Press, 2008.
2. B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006
3. RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000
4. P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008
5. Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip". Wiley, 2011

Elective III

Low Power VLSI Design

Teaching Scheme **Paper Code: VPE33**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- CO1: Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
- CO2: Characterize and model power consumption & understand the basic analysis methods.
- CO3: Understand leakage sources and reduction techniques.

Syllabus Contents:

Unit 1: Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit 2: Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3: Low Power Clock Distribution: Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew vs. tolerable skew, chip & package co-design of clock network.

Unit 4: Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

Unit 5: Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit 6: Low Power Microprocessor Design System: power management support, architectural tradeoffs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

References:

1. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002
2. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons Inc.,2000.
3. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
4. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995
5. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

Elective IV

Communication Busses and Interfaces

Teaching Scheme **Paper Code: VPE41**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Select a particular serial bus suitable for a particular application.
- Develop APIs for configuration, reading and writing data onto serial bus.
- Design and develop peripherals that can be interfaced to desired serial bus.

Syllabus Contents:

Unit 1: Serial Busses

Physical interface, Data and Control signals, features

Unit 2: limitations and applications of RS232, RS485, I_2C, SPI

Unit 3: CAN - Architecture, Data transmission, Layers, Frame formats, applications

Unit 4: PCIe - Revisions, Configuration space, Hardware protocols, applications

Unit 5: USB - Transfer types, enumeration, Descriptor types and contents, Device driver

Unit 6: Data Streaming Serial Communication Protocol

- Serial Front Panel Data Port (SFPDP) using fibre optic and copper cable

References:

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems ", Lakeview Research, 2_{nd} Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2_{nd} Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 – 200x
6. Technical references on www.can-cia.org, www.pcisig.com, www.usb.org

Elective IV

Network Security and Cryptography

Teaching Scheme **Paper Code: VPE42**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Identify and utilize different forms of cryptography techniques.
- Incorporate authentication and security in the network applications.
- Distinguish among different types of threats to the system and handle the same.

Syllabus Contents:

Unit 1: Security

- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Unit 2: Number Theory

- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Unit 3: Private-Key (Symmetric) Cryptography

- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Unit 4: Public-Key (Asymmetric) Cryptography

- RSA, Key Distribution and Management,Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Unit 5: Authentication

- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6: System Security

- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

References:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2nd Edition
3. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
4. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2nd Edition

5. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.

Elective IV

Physical Design Automation

Teaching Scheme **Paper Code: VPE43**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Study automation process for VLSI System design.
- Understanding of fundamentals for various physical design CAD tools.
- Develop and enhance the existing algorithms and computational techniques for physical design process of VLSI systems.

Syllabus Contents:

Unit 1: Introduction to VLSI Physical Design Automation.

Unit 2: Standard cell, Performance issues in circuit layout, delay models Layout styles.

Unit 3: Discrete methods in global placement.

Unit 4: Timing-driven placement. Global Routing Via Minimization.

Unit 5: Over the Cell Routing - Single layer and two-layer routing, Clock and Power Routing.

Unit 6: Compaction, algorithms, Physical Design Automation of FPGAs..

References:

Analog and Digital CMOS VLSI Design Lab

Teaching Scheme **Paper Code: VPCL3**

Lab work : 4 hrs/week

Course Outcomes:

At the end of the laboratory work, students will be able to:

- Design digital and analog Circuit using CMOS.
- Use EDA tools like Cadence, Mentor Graphics and other open source software tools like Ngspice

List of Experiments:

1) Use VDD=1.8V for 0.18um CMOS process, VDD=1.3V for 0.13um CMOS Process and VDD=1V for 0.09um CMOS Process.
    a) Plot ID vs. VGS at different drain voltages for NMOS, PMOS.
    b) Plot ID vs. VGS at particular drain voltage (low) for NMOS, PMOS and determine Vt.
    c) Plot log ID vs. VGS at particular gate voltage (high) for NMOS, PMOS and determine IOFF and sub-threshold slope.
    d) Plot ID vs. VDS at different gate voltages for NMOS, PMOS and determine Channel length modulation factor.
    e) Extract Vth of NMOS/PMOS transistors (short channel and long channel). Use VDS = 30mV
       To extract Vth use the following procedure.
        i. Plot gm vs VGS using NGSPICE and obtain peak gm point.
        ii. Plot y=ID/(gm)1/2 as a function of VGS using Ngspice.
        iii. Use Ngspice to plot tangent line passing through peak gm point in y (VGS) plane and determine Vth.
    f) Plot ID vs. VDS at different drain voltages for NMOS, PMOS, plot DC load line and calculate gm, gds, gm/gds, and unity gain frequency.

   Tabulate your result according to technologies and comment on it.

2) Use VDD=1.8V for 0.18um CMOS process, VDD=1.2V for 0.13um CMOS Process and VDD=1V for 0.09um CMOS Process.
    a) Perform the following
        i. Plot VTC curve for CMOS inverter and thereon plot dVout vs. dVin and determine transition voltage and gain g. Calculate VIL, VIH, NMH, NML for the inverter.
        ii. Plot VTC for CMOS inverter with varying VDD.
        iii. Plot VTC for CMOS inverter with varying device ratio.
    b) Perform transient analysis of CMOS inverter with no load and with load and determine tpHL, tpLH, 20%-to-80% tr and 80%-to-20% tf. (use VPULSE = 2V, Cload = 50fF)
    c) Perform AC analysis of CMOS inverter with fanout 0 and fanout 1. (Use Cin= 0.012pF, Cload = 4pF, Rload = k)
3) Use Ngspice to build a three stage and five stage ring oscillator circuit in 0.18um and 0.13um technology and compare its frequencies and time period.

4) Perform the following
   a) Draw small signal voltage gain of the minimum-size inverter in 0.18um and 0.13um technology as a function of input DC voltage. Determine the small signal voltage gain at the switching point using Ngspice and compare the values for 0.18um and 0.13um process.
   b) Consider a simple CS amplifier with active load, as explained in the lecture, with NMOS transistor MN as driver and PMOS transistor MP as load, in 0.18um technology. (W/L)MN=5, (W/L)MP=10 and L=0.5um for both transistors.
      i. Establish a test bench, as explained in the lecture, to achieve VDSQ=VDD/2.
      ii. Calculate input bias voltage if bias current=50uA.
      iii. Use Ngspice and obtain the bias current. Compare its value with 50uA.
      iv. Determine small signal voltage gain, -3dB BW and GBW of the amplifier using small signal analysis in Ngspice (consider 30fF load capacitance).
      v. Plot step response of the amplifier for input pulse amplitude of 0.1V. Derive time constant of the output and compare it with the time constant resulted from -3dB BW
      vi. Use Ngspice to determine input voltage range of the amplifier
5) Three OPAMP INA. Vdd=1.8V Vss=0V, CAD tool: Mentor Graphics DA. Note: Adjust accuracy options of the simulator (setup->options in GUI). Use proper values of resistors to get a three OPAMP INA with differential-mode voltage gain=10. Consider voltage gain=2 for the first stage and voltage gain=5 for the second stage.
      i. Draw the schematic of op-amp macro model.
      ii. Draw the schematic of INA.
      iii. Obtain parameters of the op-amp macro model such that
         a. low-frequency voltage gain = 5x104,
         b. unity gain BW (fu) = 500KHz,
         c. input capacitance=0.2pF,
         d. output resistance =_,
         e. CMRR=120dB
      iv. Draw schematic diagram of CMRR simulation setup.
      v. Simulate CMRR of INA using AC analysis (it's expected to be around 6dB below CMRR of OPAMP).
      vi. Plot CMRR of the INA versus resistor mismatches (for resistors of second stage only) changing from -5% to +5% (use AC analysis). Generate a separate plot for mismatch in each resistor pair. Explain how CMRR of OPAMP changes with resistor mismatches.
      vii. Repeat (iii) to (vi) by considering CMRR of all OPAMPs to be 90dB.
6) Technology: UMC 0.18um, VDD=1.8V. Use MAGIC or Microwind.
   a) Draw layout of a minimum size inverter in UMC 0.18um technology using MAGIC Station layout editor. Use that inverter as a cell and lay out three

cascaded minimum sized inverters. Use M1 as interconnect line between inverters.

b) Run DRC, LVS and RC extraction. Make sure there is no DRC error. Extract the netlist.

c) Use extracted netlist and obtain tPHLtPLH for the middle inverter using Eldo.

d) Use interconnect length obtained and connect the second and third inverter.

Extract the new netlist and obtain tPHL and tPLH of the middle inverter. Compare new values of delay times with corresponding values obtained in part ‘c’.

VLSI Design Verification and Testing Lab

Teaching Scheme **Paper Code: VPCL4**

Lectures: 4 hrs/week

Course Outcomes:

At the end of the laboratory work, students will be able to:

- Verify increasingly complex designs more efficiently and effectively.
- Use EDA tools like Cadence, Mentor Graphics.

List of Assignments:

1. Sparse memory
2. Semaphore
3. Mail box
4. Classes
5. Polymorphism
6. Coverage
7. Assertions

Elective V
Communication Networks

Teaching Scheme **Paper Code: VPE51**
Lectures: 3 hrs/week

Course Outcomes:
At the end of the course, students will be able to:
- Analyze protocols and algorithms, acknowledge tradeoffs and rationale
- Use routing, transport protocols for the given networking scenario and application
- Evaluate and develop small network applications

Syllabus Contents:
Unit 1: Introduction:
- Network Architecture, Performance
Unit 2: Connecting nodes:
- Connecting links, Encoding, framing, Reliable transmission, Ethernet and Multiple access networks, Wireless networks
Unit 3: Queuing models
- For a) one or more servers b) with infinite and finite queue size c) Infinite population
Internetworking:
- Switching and bridging, IPv4, Addressing, Routing Protocols, Scale issues, Routers - Architecture, IPv6
Unit 4: End-to-End Protocols:
- Services, Multiplexing, De-multiplexing, UDP, TCP, RPC, RTP
Unit 5: Congestion control and Resource Allocation
- Issues, Queuing disciplines, TCP congestion control, Congestion Avoidance, QoS
Applications:
- Domain Name Resolution, File Transfer, Electronic Mail, WWW, Multimedia Applications
Unit 6: Network monitoring – Packet sniffing tools such as Wireshark Simulations using NS2/OPNET

References:

1. Larry L. Peterson, Bruce S, Devie, “Computer Networks” , MK, 5th Edition
2. Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, MGH, International Edition 1993.
3. Vijay Ahuja, “Communications Network Design and Analysis of Computer Communication Networks”, MGH, International Editions.
4. Douglas E. Comer, “Internetworking with TCP/IP”, Pearson Education, 6th Edition

Elective V

Selected Topics in Mathematics

Teaching Scheme **Paper Code: VPE52**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Characterize and represent data collected from experiments using statistical methods.
- Model physical process/systems with multiple variables towards parameter estimation and prediction
- Represent systems/architectures using graphs and trees towards optimizing desired objective.

Syllabus Contents:

Unit 1: Probability and Statistics:

- Definitions, conditional probability, Bayes Theorem and independence.

- Random Variables: Discrete, continuous and mixed random variables, probability mass, Probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev inequality.

Unit 2: Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions.

- Pseudo random sequence generation with given distribution, Functions of a Random Variable

Unit 3: Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bi-variate normal distribution.

- Stochastic Processes: Definition and classification of stochastic processes, Poisson process

- Norms, Statistical methods for ranking data

Unit 4: Multivariate Data Analysis

- Linear and non-linear models, Regression, Prediction and Estimation

- Design of Experiments – factorial method

- Response surface method

Unit 5: Graphs and Trees:

- Graphs: Basic terminology, multi graphs and weighted graphs, paths and circuits, shortest path Problems, Euler and Hamiltonian paths and circuits, factors of a graph, planar graph and Kuratowski's graph and theorem, independent sets, graph colouring

Unit 6: Trees: Rooted trees, path length in rooted trees, binary search trees, spanning trees and cut set, theorems on spanning trees, cut sets , circuits, minimal spanning trees, Kruskal's and Prim's algorithms for minimal spanning tree

References:

1. Henry Stark, John W. Woods, "Probability and Random Process with Applications to Signal Processing", Pearson Education, 3rd Edition
2. C. L. Liu, "Elements of Discrete Mathematics", Tata McGraw-Hill, 2nd Edition

3. Douglas C. Montgomery, E.A. Peck and G. G. Vining, “Introduction to Linear Regression Analysis”, John Wiley and Sons, 2001.
4. Douglas C. Montgomery, “Design and Analysis of Experiments”, John Wiley and Sons, 2001.
5. B. A. Ogunnaike, “Random Phenomena: Fundamentals of Probability and Statistics for Engineers”, CRC Press, 2010.

Elective V

Nanomaterials and Nanotechnology

Teaching Scheme **Paper Code: VPE53**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- CO1: To understand the basic science behind the design and fabrication of nano scale systems.
- CO2: To understand and formulate new engineering solutions for current problems and competing technologies for future applications.
- CO3:To be able make inter disciplinary projects applicable to wide areas by clearing and fixing the boundaries in system development.
- CO4: To gather detailed knowledge of the operation of fabrication and characterization devices to achieve precisely designed systems.

Syllabus Contents:

Unit 1: Nanomaterials in one and higher dimensions,

Unit 2: Applications of one and higher dimension nano-materials.

Unit 3: Nano-lithography, micro electro-mechanical system (MEMS) and nano-phonics.

Unit 4: Carbon nanotubes – synthesis and applications

Unit 5 and 6: Interdisciplinary arena of nanotechnology.

References:

1. Nanoscale Materials in Chemistry edited by Kenneth J. Klabunde and Ryan M. Richards, 2nd edn, John Wiley and Sons, 2009.
2. Nanocrystalline Materials by A I Gusev and A ARempel, Cambridge International Science Publishing, 1st Indian edition by Viva Books Pvt. Ltd. 2008.
3. Springer Handbook of Nanotechnology by Bharat Bhushan, Springer, 3rdedn, 2010.
4. Carbon Nanotubes: Synthesis, Characterization and Applications by Kamal K. Kar, Research Publishing Services; 1stedn, 2011, ISBN-13: 978-9810863975..

Dissertation

Dissertation Phase – I and Phase - II

Teaching Scheme **Paper Code: MTC03 & MTC04**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Software Engineering

Program Outcomes (POs)

Students will be able to

1. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like wireless communication, networking, measurements and standards in communication.

3. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

4. Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPCT1	Programming in Java	3	0	0	40	60	100	3
SPCT2	Advanced Data Structures	3	0	0	40	60	100	3
SPC1x	**Program Elective I** 1.Machine Learning 2.Aspect oriented SE 3. Introduction to Intelligent Systems 4.Advanced DBMS	3	0	0	40	60	100	3
SPE2x	**Program Elective II** 1. Data Science 2.Distributed Systems 3. Advanced Wireless and Mobile Networks 4. Advanced Software Engineering	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
MACO1	Audit Course-1	2	0	0	40	60	100	0
SPCL1	Programming in Java Lab	0	0	4	40	60	100	2
SPCL2	Advanced Data Structures Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPCT3	Advanced algorithm	3	0	0	40	60	100	3
SPCT4	Soft Computing	3	0	0	40	60	100	3
SPE3x	**Program Elective III** 1. Data Preparation and Analysis 2. Secure Software Design & Enterprise Computing 3. Computer Vision 4. Advanced operating system	3	0	0	40	60	100	3
SPE4x	**Program Elective IV** 1. Human and Computer Interaction 2. GPU Computing 3. Digital Forensics 4. Component Based SE	3	0	0	40	60	100	3
MACO2	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
SPCL3	Advanced Algorithm Lab	0	0	4	40	60	100	2
SPCL4	Soft Computing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPE5x	Program Elective-V 1. Mobile Applications and Services 2. Compiler for HPC 3. Optimization Techniques 4. Object Oriented SE	3	0	0	40	60	100	3
MOE0x	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective
MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

DETAILED 2-YEAR CURRICULUM CONTENTS

Software Engineering

Course Code: SPCT1 **Course Name:** Programming in Java
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
- Read and make elementary modifications to Java programs that solve real-world problems.
- Validate input in a Java program.
- Identify and fix defects and common security issues in code.

Course Description:

The fundamentals of Java Programming are taught in this course. The contrast between classical and object-oriented programming will be examined, with emphasis on the latter. The latest additions to the Java language specification will be additionally covered. A comparison between C++ and Java will also be discussed, to develop an appreciation of the rationale for the emergence of these two object-oriented languages

Course Contents:

Unit-I Introduction: Introduction to Java - Features of Java - Object Oriented Concepts - Lexical Issues - Data Types - Variables - Arrays - Operators - Control Statements.

Unit-II Class: Classes - Objects - Constructors - Overloading method - Access Control- Static and fixed methods - Inner Classes - String Class - Inheritance - Overriding methods - Using super-Abstractclass.

Unit-III Packages: - Access Protection - Importing Packages - interfaces - Exception Handling - Throw and Throws - Thread - Synchronization - Messaging - Runnable Interface - Inter thread Communication - Deadlock - Suspending, Resuming and stopping threads - Multithreading.

Unit-IV I/O Streams: I/O Streams - File Streams - Applets - String Objects - String Buffer - Char Array - Java Utilities - Code Documentation.

Unit-V Socket Programming: Networks basics - Socket Programming - Proxy Servers - TCP/IP Sockets - Net Address - URL -Datagrams - Working with windows using AWT Classes - AWT Controls - Layout Managers and Menus.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Summarize the strengths and weaknesses of Java programming and the basic concepts of object-oriented programming.
- Identify Java code utilities in applets, Java packages, and classes.
- Write Java code using advanced Java features.

Text books:

- Cay S.Horstmann, Gary Cornell - Core Java 2 Volume I Fundamentals,5th Edn. PHI,2000.
- P. Naughton and H. Schildt - Java2 (The Complete Reference) - Third Edition,TMH 1999.

Reference books:

- K. Arnold and J. Gosling - The Java Programming Language - Second Edition, Addison Wesley, 1996.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105191/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCT2

Course Name: Advanced Data Structure

Course Credit Hour: 3hr

Total Contact Hour: 32hr

Course Objective:

 The course is intended to provide the foundations of the practical implementation and usage of Algorithms and Data Structures. Main aim is to ensure that the student evolves into designing and analyzing of advanced algorithms and data structures for different kinds of problems. The second objective is to expose the student to the advanced algorithm and analysis techniques.

Course Description:

- This course builds on the first year Design and Analysis of Algorithm course. It introduces students to a number of highly efficient algorithm and data structure for fundamentals computational problems across the variety of areas. Students are also introduced to techniques such as Hashing, Skip Lists, Text Processing and Computational Geometry.

Course Contents:

Unit 1 Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing,Rehashing, Extendible Hashing.

Unit 2
Skip Lists**:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3
Trees**:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4
Text Processing**:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), applying dynamic Programming to the LCS Problem.

Unit 5
Computational Geometry**:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit 6
Recent Trends in Hashing, Trees, and various computational geometry methods for efficientlysolving the new evolving problem

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1**: Able to understand and apply various hashing techniques on different set of data.
- **CLO-2**: Able understand and apply various skip list operations on various data structure elements.
- **CLO-3**: Able to understand and apply various computational geometrical methods like Two Dimensional Range Searching, Priority Search Tree, Quadtrees, and k-D Trees on various data.
- **CLO-4**: To apply various data storage algorithms on data like, BST, Red Black Tree, and Splay Tree.

Text books:

- S. Dasgupta , C.H Papadimitriou and U.V. Vazirani, Algorithms, MaGraw-Hill.
- Thomas Core Man and Ronald Rivest, Introduction to algorithms, Mcgraw-Hill

Reference books:

- J.Kleinberg and E.Tardos, Algorithm Design, Addision –Wesly

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC11 **Course Name:** Machine Learning

Course Credit Hour: 3hr **Total Contact Hour:** 32hr

Course Objective:

- The course aims to provide basic understanding of issues and challenges of Machine Learning. It aims to train the student to the basic and advanced models and algorithms of the core field of machine learning. This course also involves understanding of the strengths and weaknesses of many popular machine learning approaches.

Course Description:

- The course covers the basic concepts and techniques of Machine Learning from both theoretical and practical perspective. The material includes Introduction to machine learning and different types of learning, Linear Regression, Decision Trees, Instance based learning, Feature Selection, Neural Network, Clustering and Support Vector Machines. The students will be able to understand almost all algorithms required to develop ML applications.

Course Contents:

Unit-1: Introduction to machine learning and different types of learning: Brief Introduction to Machine Learning; Definition, Components of a learning problem, Applications, Choosing a Model Representation, Types of learning: Supervised Learning, Unsupervised Learning, Semi-supervised learning, Reinforcement Learning, Inductive Learning or Prediction,

Unit-2: Linear Regression and Decision Trees, Instance based learning and Feature Selection: Regression, Types of Regression Models (Linear Classification, Logistic Regression, Components Regression, Bias – Variance Linear Regression Multivariate Regression etc), Dimensionality Reduction Subset Selection, Shrinkage Methods, Principle Linear Discriminant Analysis Optimization, Classification-Separating Hyperplanes Classification, LMS Algorithm, Decision Tree, Over fitting, Instance- Based Learning, Basic k-nearest neighbor classification, kNN, Euclidean Distance, Feature Reduction in ML, Subset selection, Feature extraction, PCA

Unit-3: Probability and Bayes Learning, Support Vector Machines, Clustering: Probability for Learning, Bayes Theorem, MAP Learner, Naïve Bayes, Bayesian Network, Logistic Regression for classification, Support Vector Machines, Unsupervised learning, Partitioning Algorithms, Hierarchical Clustering, Density based Clustering, K-means algorithm.

Unit-4: Neural Network: Neuron, ANNs, Perceptrons, Gradient Descent, Early models, Back propagation, Initialization, Training & Validation, Parameter Estimation (Maximum Likelihood Estimation, Bayesian Parameter Estimation) Decision Trees Evaluation Measures, Hypothesis Testing Ensemble Methods, Graphical, Deep Learning, Deep Neural Network, Hierarchical Representation, Unsupervised Pre-training, Activation Functions.

Unit-5: Clustering, Gaussian Mixture Models, Spectral Clustering Ensemble Methods Learning Theory, Reinforcement Learning.

Course Learning Outcomes (CLOs):

On completion of the course students will be expected to

- **CLO-1**: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity etc,
- **CLO-2**: Have an understanding of the strength and weaknesses of many popular machine learning approaches.
- **CLO-3**: Appreciate the underlying mathematical relationship within and across Machine Learning Algorithms and the paradigm of supervised and un-supervised learning.
- **CLO-4**: Be able to design various machine learning algorithms in a range of real world applications.

Text books:

- Alpaydin E, Machine Learning, MIT Press.
- Bishop C, Pattern Recognition and Machine Learning, Springer-2006.
- Duda R, Hart E and Stork D, Pattern Classification, Wiley-Interscience.
- Mitchell T, Machine Learning, McGraw-Hill.

Reference books:

- Hastie T, Tibshirani R and Friedman J, Elements of Statistical Learning, Springer-2017.
- T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,
- Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Online links for study & reference materials:

https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC12 **Course Name:** Aspect oriented Software Engineering

Course Credit Hour: 3 **Total Contact Hour**: 32

Course Objective: Learn new skills in software development which allow you to develop significantly more flexible software. Acquire a working understanding of AOP through the use of AspectJ. Acquire a clear understanding of the adaptive object-oriented paradigm through five architectural patterns; Structure-Shy Traversal, Selective Visitor, Structure-Shy Object, Class Graph and Growth Plan. Apply the aspect-oriented paradigm and the adaptive object-oriented paradigm to problems solving, including the implementation of a project. Understand the connections between the adaptive object-oriented approach and the aspect-oriented approach and how they fit into generative programming.

Course Description: This course provides state-of-the-art techniques and concepts for software development with a focus on proper separation of concerns. We will review the history of software development and encounter different techniques for separation of concerns like functions and objects. We will identify limitations in current software development practice that lead to bad separation of concerns. We will touch on general-purpose aspect-oriented techniques (AspectJ) that lead to better separation of concerns. Then we will identify limitations in those general-purpose techniques and point to special purpose aspect-oriented techniques. We will use the Demeter Method as an example of a special purpose aspect-oriented technique.

This course introduces both the aspect-oriented and adaptive approach to software development and compares them to other approaches in the context of Generative Programming. Loose coupling between software artifacts is a theme used throughout the course. Specifically, we will learn about loose coupling between structure and behavior which leads to adaptiveness. Adaptive programming views "structure" as an aspect which crosscuts behavior. We will also look at many other aspects such as synchronization and remote invocation. We will study the basic concepts of aspect-oriented programming (an AOP system has five key ingredients) and how they relate to the concepts of adaptive programming.

Course Contents:

UNIT 1: Introduction to Aspect Oriented Paradigm, Introduction to Software Architecture, Architecture models - 4+1 views, Architecture.

UNIT2: Definition Language, Evolution – Model Driven Architecture, Component Based architecture, Service Oriented Architecture, Event Driven Architecture, Architecture models .

UNIT3: Coding Standards and Guidelines, Code reviews & Walkthroughs, Coding Principles, Code reuse ,Program analysis – slicing and merging, Correctness proof, Symbolic execution, Formal Verification Software testing objectives and principles, Verification vs. Validation, Types of testing, Cyclomatic complexity, Test Case Generation, Test tools & Models, Object-oriented Testing, Model Based testing, Test automation.

UNIT4: Software Quality Assurance and Quality control, Software Process Control, Quality factors, Quality standards – TQM, ISO, SEI CMM, PCMM, Six sigma, Reliability, Hazard, Availability, Steady State Availability, Estimation of Residual Errors, Reliability Models.

UNIT5: Software Project Management concepts, Software Project Management Plan, Tools for project plan – WBS, PERT, GANTT, Project Scheduling & Monitoring, Risk Management, Software Project Complexity, Estimation Metrics –Size Oriented and Function Point Oriented; Cost Estimation - Algorithmic Cost Modeling, COCOMO Model (including COCOMO II and advanced COCOMO), Personnel Productivity & team structure [6L]

UNIT6: Software Metrics, Significance, Project, process and product metrics, Halstead’s metrics, OO metrics –Performance Metrics, Defect Metrics Software maintenance and types, Software reengineering process model; Computer Aided Software Engineering,, building blocks for CASE, Taxonomy of CASE tools

Text Books

1. Aspect-Oriented Software Development by Robert E. Filman , Tzilla Elrad , Siobhán Clarke , Mehmet Aksit
2. Aspect-Oriented Software Development Ivan Kiselev

Online links for study & reference materials

1. NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC13 **Course Name:** Introduction to intelligence system

Course Credit Hour: 3 **Total Contact Hour**: 32

Course Objective:

- Demonstrate good knowledge of basic theoretical foundations of the following common intelligent systems methodologies: - Rule-based systems - Fuzzy inferencing - Artificial neural networks - Evolutionary computation - Data Mining 2 - Case-based reasoning - Probabilistic reasoning - Intelligent agents

- Determine which type of intelligent system methodology would be suitable for a given type of application problem

- Demonstrate, in the form of a major project work, the ability to design and develop an intelligent system for a selected application.

Course Description:

This course introduces students to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behavior including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Course Contents:

UNITI

(Introduction to AI, Intelligent Agents and Searching) Definition of AI, birth of AI, brief history, Turing test, Types of environment, Types of agents, PEAS (Performance measure , Environment, Actuators, Sensors), Introduction to searching, State Space, SAGP (State, Action, Goal test, Path cost), DFS, BFS (Completeness, Time complexity, Space complexity, Optimality), Heuristics, Local Search Algorithm, Hill Climbing.Applications of Artificial Intelligence in real word.

Unit II

(CSP, Game Playing and Logics) Constrain Satisfaction Problems examples, Approaches to solve CSPs, Test and generate method, back tracking. Game Playing, Optimal decision in games, Min Max algorithm, Evaluation functions, Introduction to Propositional Logic and First Order Logic, Syntax, Substitution, Unification, Deduction, Soundness, Completeness, Consistency, Satisfiability, Expert Systems.

Unit III

(Uncertain Knowledge, Reasoning and Machine Learning) Probabilistic Reasoning, Review of Probability Theory, Probabilistic Inference Rules, Bayes Theorem,examples of Bayes theorem, Introduction to Learning, Taxonomy of Learning Systems,Concept Learning, Find-S algorithm, Candidate Elimination Algorithm.Introduction to Neural Networks, Biological Neural Networks, Artificial Neural Networks, Perceptron, Perceptron Learning Rule, Delta Rule,Applications of Neural Networks.

Course Learning Outcomes (CLOs):

CO1:Understand concepts of Artificial Intelligence and different types of intelligent agents and their architecture.

CO2:Formulate problems as state space search problem & efficiently solve them.

CO3. Understand the working of various informed and uninformed searching algorithms and different heuristics

CO4:Understand concept of knowledge representation i.e. propositional logic, first order logic.

CO5:Reasoning with uncertainty and Machine learning algorithms.

CO6: Understand how learning happens in neural networks.

Text Books

1. Stuart Russell and Peter Norvig – Artificial Intelligence A Modern Approach, PEARSON Education.

2. Simon Haykin -Neural Networks PHI.

Reference Books

1. N. P. Padhy – Artificial Intelligence and Intelligence Systems, OXFORD publication.

2. B. YagnaNarayana - Artificial Neural Networks, PHI

Online links for study & reference materials

1. NPTEL Lecture: Prof. SudeshnaSarkar, http://nptel.ac.in/courses/106105077/

2. NPTEL Lecture: Prof. P.Das Gupta, http://nptel.ac.in/courses/106105079/

3. NPTEL Lecture: Prof. Deepak Khemani, http://nptel.ac.in/courses/106106126/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPC14

Course Name : Advanced Database Management System

Course Credit Hour : 3

Total Contact Hour : 32hr

Course Objective:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data ware housing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Description:

Focuses on concepts and structures necessary to design and implement a database management system. Various modern data models, data security and integrity, and concurrency are discussed. An SQL database system is designed and implemented as a group project.

Course Contents:

Module I Formal review of relational database and FDs Implication, Closure, its correctness

Module II 3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans.

Module III Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, Serializability.

Module IV Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC.

Module V T/O based techniques, Multi version approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases

Course Learning Outcomes (CLOs):

CLO1. For a given query write relational algebra expressions for that query and optimize the developed expressions

CLO2. For a given specification of the requirement design the databases using E R method and normalization.

CLO3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.

CLO4. For a given query optimize its execution using Query optimization algorithms

CLO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

CLO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Text books :

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts" , 6th Edition, McGraw-Hill, 9780078022159, 0078022150.

Reference books :

1 J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer SciencePress, 788175155459, 8175155450
2 R. Elmasri and S. Navathe, "Fundamentals of Database Systems" , 5th Edition, PearsonEducation 9788131716250, 8131716252
3 Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley "Foundations of Databases", 9780201537710.

Online links for study & reference materials:

https://www.geektonight.com/database-management-systems-notes-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE2X **Course Name:** Data Science

Course Credit Hour: 3 ` **Total Contact Hour**: 36hr

Course Objective:

- Obtain, clean/process, and transform data
- Analyze and interpret data using an ethically responsible approach
- Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues
- Apply computing theory, languages, and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses
- Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges
- Perform well in a group
- Interpret data findings effectively to any audience, orally, visually, and in written formats

Course Description: Get a solid basis in the informatics and statistical methodology necessary for working within Data Science.

Course Content:

Unit I Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit II Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit III Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit IV Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Unit V Applications of Data Science, Technologies for visualisation, Bokeh (Python), recent trends invarious data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Course Learning Outcomes (CLOs):

CLO1: Develop relevant programming abilities.

CLO2: Demonstrate proficiency with statistical analysis of data.

CLO3: Develop the ability to build and assess data-based models.

CLO4: Execute statistical analyses with professional statistical software.

CLO5: Demonstrate skill in data management.

CLO6: Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.

Textbooks:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.

References:

1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	**-** 05%
Assessment-2	**-** 05%
Assessment-3(Mid-exam) **-**	20%
Assessment-3	**-** 05%
Assessment-4	**-** 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 602 **Course Name:** Distributed Systems

Course Credit Hour: 3 **Total Contact Hour**: 40hr

Course Objective: To provide hardware and software issues in modern distributed systems.

- To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
- To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Course Description: This course provides a hands-on the challenges faced in constructing client/server software: partial system failures, multiple address spaces, absence of a single clock, latency of communication, heterogeneity, absence of a trusted operating system, system management, binding and naming. Techniques for meeting these challenges: RPC and middleware, naming and directory services, distributed transaction processing, 'thin' clients, data replication, cryptographic security, mobile code. Introduction to Java RMI.

Course Contents:

Unit I Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. TheoreticalFoundation for Distributed System: Limitation of Distributed system, absence of global clock,shared memory, Logical clocks, Lamport's& vectors logical clocks. Concepts in Message PassingSystems: causal order, total order, total causal order, Techniques for Message Ordering, Causalordering of messages, global state, termination detection.

Unit II Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement ofmutualexclusion theorem, Token based and non-token-based algorithms, performance metric fordistributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resourceVs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralizeddead lock detection, distributed dead lock detection, path pushing algorithms, edge chasingalgorithms.

Unit III Agreement Protocols: Introduction, System models, classification of Agreement Problem,Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution toByzantine Agreement problem, Application of Agreement problem, Atomic Commit in DistributedDatabase system. Distributed Resource Management: Issues in distributed File Systems,Mechanism for building distributed file systems, Design issues in Distributed Shared Memory,Algorithm for Implementation of Distributed Shared Memory.

Unit IV Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems.Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Unit V Transactions and Concurrency Control: Transactions, Nested transactions, Locks, OptimisticConcurrency control, Timestamp ordering, Comparison of methods for concurrency control.Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Course Learning Outcomes (CLOs):

CO1: To provide hardware and software issues in modern distributed systems.

CO2: To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3: To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

CO4: To know about Shared Memory Techniques.

CO5: Have Sufficient knowledge about file access.

Text books:

1. Singhal&Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna,Gehrke," Database Management Systems", McGraw Hill
3. Vijay K.Garg Elements of Distributed Compuitng , Wiley
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", PearsonEducation
5. Tenanuanbaum,Steen," Distributed Systems", PHI

Reference books:

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.
2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor &Fransis Group, 2007.

Online links for study & reference materials:

1. https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE23 **Course Name:** Advanced wireless & mobile Networks

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective: Signal Processing For Wireless Communication is a course offered to 1st semester M.Tech in Wireless Networks & Applications. It provides an insight into signals and system and their significance in Wireless Communication.A thorough understanding of digital signal processing fundamentals and techniques is essential for anyone whose work is concerned with signal processing applications in Wireless Communication. Digital Signal Processing begins with a discussion of the analysis and representation of discrete-time signal systems, including discrete-time convolution, difference equations, the z-transform, and the discrete-time Fourier transform. Emphasis is placed on the similarities and distinctions between discrete-time. The course proceeds to cover digital network and nonrecursive (finite impulse response) digital filters. Digital Signal Processing concludes with digital filter design and a discussion of the fast Fourier transform algorithm for computation of the discrete Fourier transform. MATLAB demos and simulation assignments will aid the students to get a deeper understanding about the concept of Signal Processing in Wireless Communication.

Course Content:

UNIT -I The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference, Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring.

UNIT –II Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- LongleyRyce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III Mobile Radio Propagation: Small –Scale Fading and Multipath: Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV Equalization and Diversity: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Nonlinear Equalization- Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
4. 4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012

REFERENCES:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.

2. Wireless Communication and Networking – William Stallings, 2003, PHI

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE24 **Course Name:** Advanced Software Engineering

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- To provide an advanced understanding and knowledge of the software engineering techniques, techniques to collect software requirements from client, testing , design and CASE tools and to understand the importance of these case tools in software development

Course Description:

- The course introduces advanced concepts in advanced software engineering including Introduction, Software Requirement Specification, Architecture and Design, Testing and CASE study. Not only do they form basic models of computation, they are also the foundation of many branches of computer science.

Course Contents:

UNIT-1 Introduction: Software engineering concepts – Development activities – Software lifecycle models **-** Classical waterfall **-** Iterative waterfall – Prototyping – Evolutionary **-** Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT-2: Software Requirement Specification: Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT-3 Architecture and Design: Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered **-** Client- server **-** Tiered **-** Pipe and filter.**-** User interface design.

UNIT-4: Testing: Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging **-** Program analysis – Symbolic execution – Model Checking.

UNIT-5: DEVOPS: DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture **-** Building and Testing-Deployment- Case study: Migrating to Micro services.

Course Learning Outcomes (CLOs):

- CLO-1: Analyze the software life cycle models
- CLO-2: Identify the importance of the software development process
- CLO-3: Able to understand business requirements pertaining to software development.
- CLO-4: Analyze the importance of CASE tools
- CLO-5: Able to understand business requirements pertaining to software development.

Text books:

- Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill.
- J. Bowan, Formal Specification and Documentation using Z - A Case Study Approach, International Thomson Computer Press.
- Antoni Diller, Z., an Introduction to Formal Methods, Wiley.

Reference books:

- M. Dyer, The Cleanroon Approach to Quality Software Development, Wiley.
- Prowell, S., Trammell, C.J. and Poore, J.H, Cleanroom Software Engineering: Technology and Process, Addison-Wesley.

Online links for study & reference materials:

1. https://nptel.ac.in/courses/106/105/106105182/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: MTC01 **Course Name**: Research Methodology and IPR

Course Credit: 2 **Total Contact Hour** : 20 hr

Course Objective :

- Identify an appropriate research problem in their interesting domain
- To explain various research designs and their characteristics
- To explain the art of interpretation, art of writing research reports and presentation skills
- To explain various forms of intellectual property, its relevance and business impact in the changing global business environment

Course Description:

This course emphasizes on the fundamental of research. The student first taught about research formulation and then what are the research designs needed according to research formulation. To understand and formulate the research problem the student should be aware of the aspect of effective literature review and the sources of information.to be taken to conduct literature review. Students are exposed to application of research design through which they understand that how, when and which design is required.In concurrence with this , the analysis part will be taught. Finally concepts related to patents, trademark and copyright will be taught.

Course Content:

UNIT 1: Meaning of research problem, sources of research problem, characteristics of good research problem, errors in selecting a research problem, scope and objectives of research problem. Appraches of investigation of solutions for research problem, data collection, analysis, interpretation. Necessary instrumentation

UNIT 2: Effective literature studies approaches, analysis, plagiarism and research ethics

UNIT-3 Effective technical writing, how to write report, paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT -4 Nature of Intellectual property; patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development, International Scenario; International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-5 Patent Rights; Scope of Patents Rights, Licensing and transfer of technology; Patent information and databases, geographical Indications.

UNIT-6 New development in IPR, Administrationof patent system, New developments in IPR, IPR of Biological system, Computer software etc. Traditional knowledge case studies, IPR and IITs.

Course Learning Outcomes (CLOs):

- Understand the characteristics, objects of good research problem.
- Understand concepts of data collection, analysis
- Understand significance, effective technical writing and report
- Understand the patent rights and transfer of technology

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- Wayne Goddard and Stuart Melville, '' Research Methodology: An Introduction''

Reference books:

- Ranjit Kumar, 2ndEdition,''Research Methodology: A step by step Guide for beginners''
- Halbert, '' Resisting Intellectual Property'', Taylor and Francis Ltd, 2007
- Mayali,'' Industrial Design'', McGraw Hill, 1992.

Online links for study and reference materials:

1. https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MAC01 **Course Name:** Value Education

Course Credit Hour: 2hr **Total Contact Hour:** 25hr

Course Objective:

1. To make students understand the relevance of individual values in everyday lives
2. To help students imbibe different individual values in their personality
3. To help students develop good moral values and positive character
4. To help students learn the significance of self management and self-control

Course Description:

The course is an appropriate combination of theoretical and industry specific contents on values and works ethics aimed at developing students into professionals. The course enables students learn concepts related to values and description of different types of values like individual values, social values, organizational values, etc. The course emphasizes on significance of cultivation of individual values that are essential in a personality and lists out various individual values to be imbibed in a student preparing for professional world. The course also describes various practical aspects of value education like managing good health, self-control, science of reincarnation, religious tolerance and role of women, which are pre-requisites for good moral character and competence.

Course Contents: The course is divided into 4 broad units namely:

Unit-1: Values and Self-development, Social Values and Individual attitudes, work ethics and Indian vision of humanism, moral and non-moral valuation, standards and principles, valuejudgments,

Unit-2: Importance of cultivation of values, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanlinesss, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline.

Unit-3: Personality and Behaviour Development, soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, freedom from anger, dignity of labour, universal brotherhood, religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature.

Unit-4: Character and Competence, holy book vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind your self, self-control, honesty, studying effectively

Course Learning Outcomes (CLOs):

CLO-1: The students will be able to relate to concepts related to value education in their everydaylives.
CLO-2: The students will be able to demonstrate individual values cultivated in their respective workplaces or professional world.
CLO-3: The students will be able to differentiate between the different types of values and imbibe them as part of their self-development.
CLO-4: The students will be able to learn and practice techniques of managing good health, self- control, gender sensitivity and religious tolerance.

Text books:

1. Indrani Majhi, Ganesh Das, VALUE EDUCATION, 1, 2017, Laxmi Publications Pvt Ltd, ISBN: 9789352741120, 9352741129
2. Sharma Sandeep, Encyclopedia of Indian Ethos and Values in Management, Anmol Publications Pvt Ltd, ISBN: 9788126139187, 9788126139187

Reference books:

1. UN-HABITAT**,** Human Values And Ethics In Workplace: Improving Leadership And Performance In The Water Education, Water Supply And Sanitation Sector, 2006, United Nations Human Settlements Programme (UN-HABITAT)
2. Ganesh A. Gayatri, Values Attitude and Practices, Publisher: Discovery Publishing Pvt. Ltd, ISBN: 9789350561287, 9789350561287
3. Atkinson Camille E., Women, Ethics and the Workplace, ABC-CLIO, ISBN: 9780275960919,9780275960919
4. Green Connie Ragen, Rethinking the Work Ethic, Hunter's Moon Publishing, ISBN: 9781937988333, 9781937988333

Online links for study & reference materials:

1. https://www.researchgate.net/publication/228079327
2. https://www.researchgate.net/publication/49586890
3. https://www.researchgate.net/publication/258040203
4. https://www.enterpreneur.com/amphtml/310254
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705678

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment -1	-05%
Assignment-2	- 05%
Assessment-3(Mid-term exam)	- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCL1 **Course Name:** Programming In Java Lab

List of Experiments

1. To print the even and odd number between 1 to 20.
2. To print the input data by using buffered Reader.
3. Find the greatest and smallest number in an array.
4. To calculate area of triangle using constructors.
5. Write a program for Method Overriding and Method Overloading.
6. To find the area of circle using abstract class
7. Write a program in threads that implements Runnable interface.
8. Write a program to compare to strings using string handling.
9. Write a program of applets that inserts image “A.jpg”.
10. Write a program in applet to make a human face.
11. Create text area, Button, Scrollbar & Menu using AWT.
12. Program to implement package and implement it.

Course Code: SPCL2 **Course Name:** Advanced Data Structure Lab

S.No	Name of Experiment
1	Write a program in C to implement following operations for Binary Search Tree ➢ Insertion ➢ Deletion ➢ Create Node ➢ In order Traversal
2.	WAP IN C for AVL Tree to implement following operations: (For nodes as integers) ➢ Create a node ➢ Right Rotate ➢ Left Rotate ➢ Get the balance factor ➢ Insert Node ➢ Delete a node ➢ Update a balance factor Print the tree
3.	WAP in python to perform string matching using Rabin-Karp algorithm.
4.	WAP to perform string matching using Knuth-Morris-Pratt algorithm.
5.	WAP in python to perform string matching using naive algorithm.
6.	Write a program in python to perform following operations on dictionaries ➢ Creating Dictionary ➢ Traversing of Dictionary(using for loop)
7.	Write Python Program to Count the Number of Characters in a string using dictionaries. Display the Keys and their values in alphabetical order.
8.	Write Python program to generate a dictionary that contains (i: i*i). Such that i is a number ranging from 1 to n.
9.	Write a program in python to Demonstrate Nested Dictionaries.
10.	Write a program in python which demonstrate working of hash.

Course Code: SPCT3 **Course Name:** Advanced Algorithm
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description:

This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. There will also be a brief introduction to complexity theory, the formal study of algorithm performance. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Course Contents:

Unit-I

Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge- weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example ofamortized analysis.

Unit-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations,LUP-decomposition

Unit-IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application:Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced NumberTheoretic Algorithm

Unit-VI

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyze worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Text books:

- Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. *Algorithms*. McGraw-Hill, 2006. ISBN: 9780073523408.
- Kleinberg, Jon, and Eva Tardos. Algorithm Design. Addison-Wesley, 2005. ISBN: 9780321295354.

Reference books:

- Even, Shimon. Graph Algorithms. Computer Science Press, 1979. ISBN: 9780914894216.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105157/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCT4 **Course Name:** Soft Computing

Course Credit Hour: 4hr **Total Contact Hour:** 35hr

Course Objective:

- The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.
- Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning.
- Provide the mathematical background for carrying out the optimization associated with neural network learning.

Course Description:

- The course introduces fundamental concepts in Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning. The properties of these concepts will be studied and various rigorous techniques for analyzing and comparing them will be discussed and implemented by using Python and MATLAB.

Course Contents:

Unit-1 INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

Unit-2 FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems,Fuzzy Decision Making.

Unit-3 NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit-4 GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit-5 Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

Unit-6 Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Course Learning Outcomes (CLOs) :

Students will be able to**:**

- CLO-1: Describe human intelligence and AI Explain how intelligent system works.
- CLO-2: Apply basics of Fuzzy logic and neural networks.
- CLO-3 : Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- CLO-4 : Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
- CLO-5: Implement Fuzzy logic and ANN methods using Python/MATLAB.

Text books:

- J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education.
- Simon O. Haykin “Artificial Neural Network”, PHI.
- Elaine Rich, Kevin Knight, Artificial Intelligence, TMH.

Reference books:

- Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill.
- Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley.
- S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105173/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE31 **Course Name:** Data Preparation & Analysis

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- Recognize the relative impact of data quality and size to algorithms.
- Set informed and realistic expectations for the time to transform the data.
- Explain a typical process for data collection and transformation within the overall ML workflow.
- Collect raw data and construct a data set.
- Sample and split your data set with considerations for imbalanced data.
- Transform numerical and categorical data.

Course Contents:

Unit I : Data Gathering and Preparation: Data formats, parsing and transformation, Scalability andreal-time issues.

Unit II : Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformationand segmentation.

Unit III: Exploratory Analysis: Descriptive and comparative statistics, Clustering and association,Hypothesis generation.

UnitIV : Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.

Unit V: Visualizations using R

Course Learning Outcomes (CLOs) :

CLO1: Engage in continuous reflective learning in the context of technology and scientific advancement.

CLO2: Identify the need and scope of the Interdisciplinary research.

CLO3: Enhance research culture and uphold the scientific integrity and objectivity

CLO4: Understand the professional, ethical and social responsibilities

CLO5: Understand the importance and the judicious use of technology for the sustainability of the environment

CLO6: Enhance disciplinary competency, employability and leadership skills.

Text books:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Online links for study & reference materials:

1. NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE32

Course Name : Secure Software design & enterprise computing

Course Credit Hour : 3

Total Contact Hour : 30hr

Course Objective: Students will learn that how the security aspects of software development are embedded into the system to be developed. It includes secure architecture design, secure coding, secure deployment and secure software development methodologies.

Course Contents:

Unit-I Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit –II Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Present software solution.

Unit –III Enterprise Network Management: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them, Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum Vulnerabilities and flaws.

Unit –IV Enterprise Systems Administration: Design, implement and maintain a directorybased server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit –V Software Security in Business Enterprise: Identification and authentication, Enterprise Information Security, Symmetric and asymmetric cryptography, Access control models, Kerberos protocol, Protocols specially designed for e-commerce and web applications, firewalls and VPNs. Management issues, technologies, and systems related to information security management at enterprises.

Unit –VI Case Studies: Case study of DNS server, Case study on DHCP configuration and Case study on SQL injection attack, Case study on Terminal services.

Course Learning Outcomes (CLOs):

1. Differentiate between various software vulnerabilities

2. Identify software process vulnerabilities for an organization

3. Monitor resources consumption in a software

4. Interrelate security and software development process

Text books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley
3. W. Stallings, Cryptography and network security: Principles and practice, Prentice Hall.

Reference books:

1. C. P. Pfleeger, S. L. Pfleeger, Security in Computing, Prentice Hall
2. Gary McGraw, Software Security: Building Security In, Addison-Wesley

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE33 **Course Name :** Computer Vision

Course Credit Hour: 3 **Total Contact Hour:** 30hr

Course Objective:
To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications

Course Contents:

UNIT1 :- Image Formation Models: Monocular imaging system, Orthographic& Perspective Projection, Camera model and Camera calibration, Binocular imaging systems

UNIT II:- Image Processing and Feature Extraction: mage representations (continuous and discrete), Edge detection.

UNIT III:- Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motionestimation, Structure from motion

UNIT IV :-Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi Resolution analysis

UNIT V:- Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component analysis, Shape priors for recognition.

Course Learning Outcomes (CLOs):

CLO1: Identify basic concepts, terminology, theories, models and methods in the field of computer vision.

CLO2: describe known principles of human visual system.

CLO3: describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.

CLO4: suggest a design of a computer vision system for a specific problem.

Text books:
1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Reference books:
1. Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)
2. Haralick& Shapiro, "Computer and Robot Vision", Vol II
. G_erardMedioni and Sing Bing Kang "Emerging topics in computer vision"
4. Emanuele Trucco and AllessandroVerri "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
5. Olivier Faugeras, "Three-Dimensional Computer Vision", The MIT Press, 1993.

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE34 **Course Name :** Advanced Operating System

Course Credit Hour : 3 **Total Contact Hour :** 30hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

ModuleI : FUNDAMENTALSOF OPERATING SYSTEMS

Overview – Synchronization Mechanisms , Processes and Threads , Process Scheduling , Deadlocks: Detection, Prevention and Recovery, Models of Resources, Memory Management Techniques.

ModuleII:DISTRIBUTEDOPERATING SYSTEMS

Issues in Distributed Operating System , Architecture , Communication Primitives , Lamport's Logical clocks, Causal Ordering of Messages, Distributed Mutual Exclusion Algorithms, Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols.

ModuleIII:DISTRIBUTEDRESOURCEMANAGEMENT

Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery, Fault Tolerance , Two-Phase Commit Protocol, Non blocking Commit Protocol , Security and Protection.

ModuleIV : REAL TIME AND MOBILE OPERATING SYSTEMS

Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems , Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management , File system.

ModuleV : CASE STUDIES

Linux System: Design Principles , Kernel Modules, Process Management Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication. iOS and Android: Architecture and SDK Framework , Media Layer, Services Layer, Core OS Layer, File System.

Course Learning Outcomes (CLOs):

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Text books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1.NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE41

Course Name: Human Computer Interaction

Course Credit Hour: 3

Total Contact Hour: 35hr

Course Objective:

- Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
- Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

Upon successful completion of this course, students should be able to:

- Design, implement and evaluate effective and usable graphical computer interfaces.
- Describe and apply core theories, models and methodologies from the field of HCI.
- Describe and discuss current research in the field of HCI

Course Contents:

Unit 1 Introduction: Importance of user Interface – definition, importance of 8 good design. Benefits ofgood design. A rief history of Screen design. The graphical user interface – popularity of raphics,theconceptofdirectmanipulation,graphicalsystem,Characteristics,Webuser Interfacepopularity,characteristics-'rinciples of user interface.

Unit 2 Designprocess: Human interaction with computers, importance of 8 human characteristics human consideration,Human interaction speeds,understanding business junctions.IIIScreen Designing:Design goals.

Unit 3 ScreenDesigning: Designgoals–Screenplanningandpurpose,8organizingscreenelements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition –amount of information – focus and emphasis – presentation information simply and meaningfully –informationretrievalonweb–statisticalgraphics–Technologicalconsiderationininterfacedesign.

Unit 4 Windows: New and Navigation schemes selection of window, 8 selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors ,uses problems, choosing colors.

Unit 5

Softwaretools: Specificationmethods,interface–BuildingTools.8InteractionDevices– Keyboardandfunctionkeys–pointingdevices–speechrecognitiondigitizationandgeneration–image and video displays –drivers.

Course Learning Outcomes (CLOs):

CLO1: Understand fundamental design and evaluation methodologies of human computer interaction.

CLO2: Demonstrate knowledge of human computer interaction design concepts and related methodologies.

CLO3: Apply theories and concepts associated with effective work design to real-world application

Text books:

1. AlanDix,JanetFinlay,GregoryAbowd,RussellBealeHumanComputer Interaction,3rdEditionPrenticeHall,2004.
2. JonathanLazarJinjuanHeidiFeng,HarryHochheiser,ResearchMethodsinHumanComputerInteraction,Wiley,2010.
3. BenShneidermanandCatherinePlaisantDesigningtheUserInterface:StrategiesforEffectiveHuman-ComputerInteraction(5thEdition,pp.672,ISBN0-321-53735-1,March2009),Reading,MA:Addison-WesleyPublishingCo.

Reference books:

1. “Human-Computer Interaction” by Dix
2. “Designing the User Interface: Strategies for Effective Human-Computer Interaction” by Shneiderman

Online links for study & reference materials:

https://guides.lib.uw.edu/research/hcid/hcid-rec

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE42 **Course Name:** GPU Computing

Course Credit Hour: 3hr **Total Contact Hour:** 32 hr

Course Objective: General Purpose Graphical Processing Units (GPGPU) primarily refers to the use of GPUs for computationally intensive mathematical and scientific computing. The enormous peak performance of GPUs for arithmetically intensive computations relatively at a much lower cost compared to CPUs makes GPU computing a very attractive new alternative for computationally demanding problems.

Course Description: Understanding the basic concepts of GPU programming, CUDA (Compute Unified Device Architecture) parallel computing platform and hands-on experience on implementing some standard CUDA programs. Finally the course will give a brief overview of the current applications and future trends of GPU computing in scientific research.

Course Contents:

- **Introduction** (2 + 1): History, graphics processors, graphics processing units, GPGPUs. Clock speeds, CPU / GPU comparisons, heterogeneity. Accelerators, parallel programming, CUDA / OpenCL / OpenACC,
- **Hello World Computation** (3 + 1) Kernels, launch parameters, thread hierarchy, warps / wavefronts, thread blocks / workgroups, streaming multiprocessors, 1D / 2D / 3D thread mapping, device properties, simple programs
- **Memory** (8 + 2) : Memory hierarchy, DRAM / global, local / shared, private / local, textures, constant memory. Pointers, parameter passing, arrays and dynamic memory, multi-dimensional arrays. Memory allocation, memory copying across devices. Programs with matrices, performance evaluation with different memories
- **Synchronization** (6 + 2): Memory consistency. Barriers (local versus global), atomics, memory fence. Prefix sum, reduction. Programs for concurrent data structures such as worklists, linked-lists. Synchronization across CPU and GPU
- **Functions** (3 + 1): Device functions, host functions, kernels, functors. Using libraries (such as Thrust), developing libraries.
- **Support** (1 + 2): Debugging GPU programs. Profiling, profile tools, performance aspects
- **Streams** (3 + 1): Asynchronous processing, tasks, task-dependence. Overlapped data transfers, default stream, synchronization with streams. Events, event-based-synchronization
  - overlapping data transfer and kernel execution, pitfalls.
- **Case studies** (3 + 2) : Image processing. Graph algorithms. Simulations. Deep learning.
- Advanced topics (8 + 2) : Dynamic parallelism. Unified virtual memory. Multi-GPU processing. Peer access. Heterogeneous processing

Course Learning Outcomes (CLOs):

CLO1: Describe common GPU architectures and programming models.

CLO2: Describe common GPU architectures and programming models

CLO3: Implement efficient algorithms for common application kernels, such as matrix multiplication.

CLO4: Given a problem, develop an efficient parallel algorithm to solve it.

CLO5**:** Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining your achievements.

Reference Books:

1. Programming Massively Parallel Processors: A Hands-On Approach, 2nd Edition, David Kirk and Wen-mei Hwu, Publisher: Morgan Kaufman, 2012, ISBN: 9780124159921

Online links for study & reference materials:

1. **MPI: www.mcs.anl.gov/mpi/**

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE43

Course Name: Digital Forensics

Course Credit Hour: 3hr

Total Contact Hour: 32 hr

Course Objective: Student can identify, analyze and remediate computer security breaches by learning and implementing the real-world scenarios in Cyber Investigations Laboratory, Network Security Laboratory and in Security and Penetration Testing Laboratory. Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer

- Networks in an Organization.
- Understand key terms and concepts in Cryptography, Governance and Compliance.
- Develop cyber security strategies and policies
- Understand principles of web security and to guarantee a secure network by monitoring
- Analyzing the nature of attacks through cyber/computer forensics software/tools.

Course Description: Introduces computer security administrators to computer forensics. Includes setup and use of an investigator's laboratory, computer investigations using digital evidence controls, processing crime and incident scenes, performing data acquisition, computer forensic analysis, e-mail investigations, image file recovery, investigative report writing, and expert witness testimony.

Course Contents:

UNIT 1: Review of Computer Investigations

A. Case examination and assessment

B. Evidence gathering

C. Systematic approaches to computer investigations

D. Conducting an investigation

UNIT 2: Review Operating and File Systems

A. Review of file structures, boot processes, and data structures of popular operating systems.

B. NTFS

C. Macintosh

D. Linux

UNIT3: Preparing Media to Accept an Image

A. Create a partition

B. Wipe partition using DOD standard

C. Verify wipe of partition

UNIT4: Digital Forensics Evidence

A. Restoring a Hard Disk Image

B. Verifying restore was successful

C. Boot to the evidence Operating System

UNIT 5: Data Acquisition

A. Identify methods

B. Utilization of various data acquisition tools

UNIT6: Computer Forensic Analysis

A. Concepts

B. Utilization of various analysis tools

C. Recognizing, locating, recovering and analyzing images

D. Processing evidence with FTK E. Data Carving

F. Searching the Registry

UNIT 7: Linux Forensics

A. Linux Distributions

B. Boot block, superblock, inode block and data block

C. Understanding inodes

D. Linux Loader & GRUB

E. Linux drives and partition schemes

F. Sleuth Kit, Autopsy, HELIX and KNoppix

UNIT 8: MAC Forensics

A. HFS, HFS+

B. Finder, File Manager

C. Macintosh acquisition methods using MacQuisition

D. Using Black Bag Tools

UNIT9: Computer Forensic Investigation Reporting

A. Reporting guidelines

B. Witness Requirements

UNIT 10: Anti Forensics

A. Traditional methods

1. Overwriting Data and Metadata
2. Cryptography, Steganography, and other Data Hiding Approaches
3. Decrypting EFS with FTK.

B. Non-traditional methods

1. Targeting forensic tool blind spots
2. Targeting forensic tool vulnerabilities
3. Targeting generic tool/lib vulnerabilities

C. Review of current tools & techniques

Course Learning Outcomes (CLOs):

a) Analyze and evaluate the cyber security needs of an organization.

b) Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

c) Measure the performance and troubleshoot cyber security systems.

d) Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.

e) Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators

f) Design and develop security architecture for an organization.

g) Design operational and strategic cyber security strategies and policies.

Text Books:

1. "Digital Forensics and Cyber Crime" by Joshua I James and Frank Breitinger
2. "Forensics Computer Investigator, Digital Forensics Analyst, Job Interview Bottom Line Practical Questions and Answers" by M Kumar
3. "Digital Forensic and Cyber Crime" by R K Jha

Reference Books:

1. "National Security and Counterintelligence in the Era of Cyber Espionage (Advances in Digital Crime, Forensics, and Cyber Terrorism)" by Eugenie de Silva.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE44 **Course Name:** Component Based Software Engineering

Course Credit Hour: 3hr **Total Contact Hour:** 32 hr

Course Objective:

- The aim is to gain the knowledge of current component based models in terms of their design, management and implemented issues. This course will provide in depth knowledge of all the component based so0ftware engineering practices.

Course Description:

- The course introduces fundamental concepts in component based software engineering theory and implementation issues. It includes Component-oriented programming, CBSE process and life cycle models, Component-based design and reuse and Component technologies.

Course Contents:

UNIT I- Introduction to CBSE

Component-Based Software Engineering (CBSE), CBSE vs. Object-Oriented Software Engineering, CBSE methodology, domain engineering, component engineering, component vs. object, Component, component technology, software component, specification of software component, measurement and metrics for CBSE, challenge of CBSE, advantages and disadvantages of CBSE.

UNIT II- Component-Oriented Programming

Component-oriented programming, principle of component-oriented programming, object-oriented programming to component-oriented programming, component-oriented programming vs. object-oriented programming.

UNIT III- CBSE Process and Life Cycle Models

CBSE processes, component-based software life cycle, component selection, component adaptability, component certification, component composition.

UNIT IV- Component-Based Design and Reuse

Principles of component design and reuse, design prototyping, design production, design refactoring, design documentation, component-based software reuse, reusable component, component-based reuse metrics.

UNIT V- Component Technologies

Component technologies: Component Object Model (COM), Distributed Component Object Model (DCOM), Common Object Requesting Broker Architecture (CORBA), Enterprise Java Beans (EJB).

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Understand and analyze various methods and techniques of CBSE life cycle models.
- **CLO-2**: Design and implement all modules related to Component –Oriented Programming
- **CLO-3**: Get in depth knowledge of all issues related to Component based design and reuse.
- **CLO-4**: Get in depth knowledge of all latest technologies of component technologies like, COM, DCOM, CORBA and EJB.

Text Books:

- George T. Heineman, William T. Councill, Component-Based Software Engineering: Putting the Pieces Together, Addision Wesley
- Andy JuAn Wang, Kai Qian, Component-Oriented Programming, Willey Interscience

Reference Books:

- Clemens Szyperski, Component Software: Beyond Object-Oriented Programming, Addison Wesley.
- Alan W. Brown, Component-Based Software Engineering, Wiley-IEEE Computer Society.
- Sudha Sadasivam, Component-Based Technology, G. Willy.
- Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc.
- N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co. (P) Ltd., New Delhi.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/101/106101061/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MACO2 **Course Name**: Disaster Management

Course Credit Hour: 2 **Total Contact Hour** : 20 hr

Course Objectives: -Students will be able to:
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in Syllabus

Course Content:

1 Introduction
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 Repercussions of Disasters And Hazards:
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

3 Disaster Prone Areas In India
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post Disaster Diseases And Epidemics

4 Disaster Preparedness And Management
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

5 Risk Assessment
Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Assessment. Strategies for Survival.

6 Disaster Mitigation
Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:
1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep &Deep publication Pvt. Ltd., New Delhi.

Course Code: SPCL3 **Course Name:** Advanced Algorithm Lab

List of Experiments

1. Write a program to sort a given set of elements using Merge Sort
2. Write a program to implement Floyd Warshall's algorithm.
3. Write a program to implement Kruskal minimum spanning tree algorithm.
4. Write a program to print all the nodes reachable from a given starting node in a digraph using BFS method
5. Write a program to find shortest paths to other vertices using Dijkstra's algorithm., rom a given vertex in a weighted connected graph,
6. Write a program to find a subset of a given set S = {s1,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.
7. Write a program to perform fast fourier transform
8. Write a program to implement Strassen's matrix multiplication algorithm.
9. Write a program to implement Knapsack algorithm.
10. To Study Np-Complete Theory

Course Code: SPCL4 **Course Name:** Soft Computing Lab

List of Practical

1. Write a program in python to find the simple interest.
2. Write a program in python to find the compound interest.
3. Write a Program in python to check the given year is a leap year or not.
4. Write a program in python to check whether a given number is Fibonacci number or not.
5. Write a program in python to multiply two matrices.
6. Write a program in python to calculate average of numbers.
7. Write a program in python to check reverse number is equals to original number.
8. Write a program in python to check whether a given number is prime or not.
9. Write a program in python to generate a random number.
10. Write a program in python to swap two variables.

Course Code: SPE51

Course Name: Mobile Application and Services

Course Credit Hour:3hr

Total Contact Hour:32hr

Course Objective:

- Learn to setup Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications.

Course Description:

- Catalog description: Mobile application development frameworks; Architecture, design and engineering issues, techniques, methodologies for mobile application development. – Additional Notes: Course material includes readings from textbooks, reference books, and research papers and articles.

Course Contents:

Unit-1
Get started, Build your first app, Activities, Testing, debugging and using support libraries

Unit-2
User Interaction, Delightful user experience, Testing your UI

Unit-3
Background Tasks, Triggering, scheduling and optimizing background tasks

Unit-4
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders

Unit-5
Permissions, Performance and Security, Firebase and AdMob, Publish

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:** Able to understand to Create, test and debug Android application by setting up Android development environment
- **CLO-2:** Able understand to Implement adaptive, responsive user interfaces that work across a wide range of devices.
- **CLO-3:** Able to analyze performance of android applications and understand the role of permissions and security
- **CLO-4:** Demonstrate methods in storing, sharing and retrieving data in Android applications.

Text books:

- Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developerfundamentals-course-concepts/details (Download pdf file from the above link)

Reference books:

- Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014.
- Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015.
- J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
- Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE52 **Course Name:** Compiler for HPC

Course Credit Hour:3hr **Total Contact Hour:**32hr

Course Objective:

- To develop problem solving abilities using HPC
- To develop time and space efficient algorithms.
- To study algorithmic examples in distributed, concurrent and parallel environments.

Course Description:

- This course is using the concepts of compilers and its related topic in context of high performance computing (includes Parallel Processing Concepts, Design Issues in HPC, Synchronization and related algorithms, Advanced tools, techniques and applications).

Course Contents:

Unit-1

Parallel Processing Concepts: Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Organization and Contents of the Text, Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines Levels of parallelism (instruction, transaction, task, thread, memory, function) Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Comp.

Unit-2

Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architecture examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larra bee Micro architecture and Intel Nehalem micro-architecture Memory hierarchy and transaction specific memory design, Thread Organization.

Unit-3

Fundamental Design Issues in HPC: Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication

Unit-4

Synchronization and related algorithms : Synchronization: Scheduling, Job Allocation, Job Partitioning, Dependency Analysis Mapping Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, Open MP: a Standard for Directive Based Parallel Programming.

Unit-5

Advanced tools, techniques and applications: Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their limitations, Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Sorting: Issues, Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort, Shared-Address-Space Parallel Formulation, Single -Source Shortest Paths- Distributed Memory Formulation. HPC enabled Advanced technologies : Search Algorithms for Discrete Optimization Problems: Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Introduction to (Block Diagrams only if any) Peta scale Computing, Optics in Parallel Computing Quantum Computers, Recent developments in Nanotechnology and its impact on HPC Power-aware Processing Techniques in HPC .

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:** Understand the role of HPC in science and engineering.
- **CLO-2:** Be familiar with popular parallel programming paradigms.
- **CLO-3:** Understand commonly used HPC platforms with particular reference to Cluster system.
- **CLO-4:** Understand the means by which to measure, assess and analyse the performance of HPC applications.
- **CLO-5:** Understand the role of administration, workload and resource management in an HPC management software.
- **CLO-6:** Understand the mechanisms for evaluating the suitability of different HPC solutions to solving scientific problems.

Text books:

- Kai Hwang,"Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill 1993
- David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A hardware/Software Approach", Morgan Kaufmann,1999.

Reference books:

- Kai Hwang,, "Scalable Parallel Computing", McGraw Hill 1998
- Peter Pacheco, Introduction to Parallel Programming, Morgan Kaufmann Publishers, 2011;
- Michael J. Quinn, Parallel programming in C with MPI and OpenMP, McGraw-Hill Higher Education, 2004;
- William Gropp, Using MPI: portable parallel programming with the message-passing interface, MIT press, 1999;

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE53 **Course Name:** Optimization Techniques

Course Credit Hour:3hr **Total Contact Hour:**32hr

Course Objective:

- Learn to Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models. Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex and revised simplex methods, Exceptional cases in LP, Duality theory, Dual Simple method, Sensitivity analysis. Network Analysis: Transportation problem (with transshipment).

Course Description:

- This course deals with optimization techniques (linear and non-linear) used in engineering.Free slack, Total slack, Crashing, Resource allocation. Non-Linear Programming: Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions.

Course Contents:

Unit-1
Introduction to Optimization: Historical Development, Engineering applications of Optimization, Design, vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems

Unit-2
Classical Optimization Techniques: Single variable optimization, Constrained and unconstrained multi-variable, optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions

Unit-3
Linear Programming: Statement of an LP problem, Graphical Solution of an LP problem, Simplex, method, Dual simplex method
Non-linear Programming: One-dimensional minimization method Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, 06 Interval halving method, Fibonacci method, Golden section method, Direct root methods

Unit-4

Non-linear Programming: Unconstrained Optimization Techniques Direct Search Methods: Random search methods, Grid search method, Univariate method, Hookes and Jeeves' method, Powell's method, Indirect Search Methods: Steepest descent method, Fletcher-Reeves method, Newton's method. **Non-linear Programming:** Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming, Indirect methods: Transformation techniques, Exterior penalty function method, Interior penalty function method

Unit-5
Evolutionary Algorithms An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:**Students will be able to understand basic theoretical principles for formulation of optimization models and its solution.
- **CLO-2:**Students will be able to learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques.
- **CLO-3:**Students should be able to apply detailed theoretical and practical aspects of 35% intelligent modelling, optimization and control of linear and non-linear systems

Text books:

- Taha, H.A., Operations Research: An Introduction, Prentice Hall of India (2007) 8th ed. • Kasana, H.S., Introductory Operation Research: Theory and Applications, Springer Verlag (2005).
- Rardin, Ronald L., Optimization in Operations research, Pearson Education (2005). Ravindran A, Phllips D.T. and Solberg J.J. Operation Research: Principles and Practice, John Wiley (2007).

Reference books:

- Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
- Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publicationsposing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2.
- Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication

Online links for study & reference materials:

1. https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE54

Course Name: Object –Oriented Software Engineering

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

- The aim is to gain the knowledge of current object- based models in terms of their design, management and implemented issues. This course will provide in depth knowledge of all the object- based software engineering practices.

Course Description:

- The course introduces fundamental concepts in object- based software engineering theory and implementation issues. It includes Object-oriented programming, OOSE process and life cycle models, COCOMO Model, Requirement Elicitation, Component Inspection, Usability Testing and UML Technologies.

Course Contents:

UNIT -1: Basic Concepts; Project Organization; Communication - Synchronous, Asynchronous; Life Cycle Model - Sequential, Iterative, Entity centered Model; Project Estimation - COCOMO, COCOMO– II, Agile Process.

UNIT -2: Requirement Elicitation - Concepts, Activities, Managing; Analysis - Concept, Activities; Design - Concepts, Activities. Object Design Specifying Interfaces – Interfaces Specification Concepts, Interface Specification Activities.

UNIT -3: Mapping Concepts; Testing – Concepts, Activities – Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, Configuration Management Concepts.

UNIT -4: UML Diagrams – Use Case, Class, Interaction, State Chart, Activity Diagrams. Case Study – Problem Statements & UML Diagrams of Library Management, ATM Management, and Railway Ticket Reservation Systems.

Course Learning Outcomes (CLOs): On completion of the course students will be able to:

- **CLO-1**: Understand and analyze various methods and techniques of OOSE life cycle models.
- **CLO-2**: Understand various requirement elicitation techniques using various methods.
- **CLO-3**: Design various kinds of test cases using various testing techniques like, Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, and Configuration Management.
- **CLO-4**: Get in depth knowledge regarding UML diagrams using Use Case, Class, Interaction, and State Chart.

Text books :

- Bernd Bruegge, Alan H Dutoit, “Object Oriented Software Engineering” Second Edition, Pearson Education.
- Stephen Schach, “Applying UML and Patterns”, Third Edition, Pearson Education.

Reference books :

- Pressman Roger S., Software Engineering: Practitioner’s Approach, McGraw-Hill Inc.
- N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co. (P) Ltd., New Delhi

Online links for study & reference materials :

https://nptel.ac.in/courses/106/101/106101061/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MOE 0x **Course Name:** Waste to Energy

Course Credit Hour: 3 **Total Contact Hour:** 40hr

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants– Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

BUILDING CONSTRUCTION AND MANAGEMENT

Course Curriculum

FOR M.TECH- BUILDING CONSTRUCTION AND MANAGEMENT COURSE
(Effective from Academic session 2019-2020)

Introduction-

Masters in Civil Engineering program imparts advanced knowledge in the concerned field of specialization and prepares students for multitude career opportunities in different sectors and opens amazing job options after the completion of degree. M.Tech in Building construction and management is a 2 year postgraduate professional degree program. This program includes construction and maintenance activities for public works like dam construction, buildings, roads, bridges, airports, sewage systems. The course work of this specialization includes topics of construction, material management, maintenance and repairing work. This course is divided into 4 semesters, first three semesters are related to course work and forth semester is based on research work. M.Tech in Building construction and management holders can be employed in designing, construction site areas of various construction companies. They can be employed for managerial positions. Civil engineers are in great demand to build and repair structures and current facilities or to construct the new structures and buildings.

Program Educational Objectives (PEOs)

The Programme of Building Construction and Management has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

PEO1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in built environment issues through new ideas and knowledge.

PEO2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.

PEO3: Provide sound theoretical and practical knowledge of Civil Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.

PEO4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.

PEO5: Ability to engage with other socio- economic activity and perform standard competencies at national and local practice of architecture with the integration of other engineering disciplines

Programme specific outcome (PSO)

PSO-1 They will study about Construction materials and equipments.

PSO-2 Will learn how to manage and select a site and start a project and manage various obstruction and risk management in any project.

PSO-3 Gain knowledge of construction materials and how to use them in construction purposes.

PSO-4 Get acquainted with computer applications and develop keen knowledge of Management softwares.

PSO-5 Develop knowledge on different areas of construction equipments and materials.

PSO-6 Be aware of risk and obstruction and will learn to manage.

PSO-7 In laboratory, will learn Auto CAD software, MSP, PRIMAVERA softwares, BIM etc.

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of M.Tech:

- Every semester shall offer a minimum of **16 credits** and a maximum of 18 **credits**.
- Credits for the Project or Thesis can vary from 10 to 16.
- The total number of credits for the M. Tech Degree Course could vary from a **minimum of 68** credits to a **maximum of 78** credits.
- All courses of study put together would engage the students for a **minimum of 14 periods** or hours of study a week and a **maximum of 20 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the M.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
    (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
    (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate's proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits	Percentage
1	Humanities and Social Sciences including Management courses	0	
2	Basic Science courses	0	
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	10	
4	Professional core courses	9	
5	Professional Elective courses relevant to chosen specialization/branch	18	
6	Open subjects – Electives from other technical and /or emerging subjects	3	
7	Project work, seminar and internship in industry or elsewhere	28	
8	Mandatory Courses	0	
		68	

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
PCC : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

Master of Technology- Building Construction and Management (CE)

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
CPCT1	Advance Construction Techniques	3	0	0	40	60	100	3
CPCT2	Eco-Friendly Construction	3	0	0	40	60	100	3
CPE1C	Program Elective-1 (1) Contract Law & Regulations (2) Construction Productivity (3) Construction Engineering Materials	3	0	0	40	60	100	3
CPE2C	Program Elective-2 (1) Repairs & Rehabilitation of Structures (2) Construction Cost Analysis (3)Contract Management	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
MAC0C	Audit Course-1	2	0	0	40	60	100	0
CPCL1	Advanced CAD Lab	0	0	4	40	60	100	2
CPCL2	Construction management Lab 1	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
CPCT3	Construction Planning Scheduling & Control	3	0	0	40	60	100	3
CPCT4	Construction Personnel Management	3	0	0	40	60	100	3
CPE3C	Program Elective-3 (1) Construction Economics & Finance Management (2)Sustainable Construction Methods (3) Construction Equipement &Automation	3	0	0	40	60	100	3
CPE4C	Program Elective-4 (1) Quality Control & Project Safety (2) Energy Conservation Techniques in Building Construction (3) Building Services	3	0	0	40	60	100	3
MAC0C	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
CPCL3	Computer Application in Construction Engineering & Planning Lab	0	0	4	40	60	100	2
CPCL4	Construction management Lab 2	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
CPE5C	Program Elective-5 (1) GIS in Construction Engineering & Management (2) Modern Construction Materials Methods & Equipments (3) Resource Management & Control in Construction	3	0	0	40	60	100	3
MOE0C	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

Semester	**Credits**		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16

SEMESTER-I

ADVANCED CONSTRUCTION TECHNIQUES

Course Code: CPCT1 **Course Name** ADVANCED CONSTRUCTION TECHNIQUES

Course Objective:

A basic ability to plan, control and monitor construction projects with respect to time and cost An idea of how to optimize construction projects based on costs

Course Description:

An idea of how to optimize construction projects based on costs

Course Credit Hour : 3 Hour **Total Contact Hour:32**

Unit I **Sub Structure Construction -**
Box jack in - Pipe Jacking Under Water Construction of diaphragm walls and Basement - Tunneling Techniques – Piling Techniques – Driving Well And Caisson Sinking Coffer dam - Cable Anchoring And Grouting Driving Diaphragm Walls, Sheet Piles Laying Operations For Built Up Offshore System-Shoring For Deep Cutting- Large Reservoir Construction with membrane sand Earth system - well points - Dewatering and stand by Plant equipment for underground open excavation

Unit II
Super Structure Construction - Vacuum dewatering of concrete flooring - Concrete paving technology - Techniques of construction for continuous concreting operation in Tall buildings of various shapes and Varying sections - Launching Techniques - Suspended form work - erection techniques of tall structures, Larges pan structures - Launching techniques for heavy decks - in - sit upre - stressing in high rise structures, aerial transporting, handling, erecting lightweight components on tall structures - erection of lattice tower sand rigging of transmission line structures

Unit III
Construction Sequences - in cooling towers, Silos Chimney, Skyscrapers, bow string bridges, cable stayed bridges - Launching and pushing of boxdecks - support structure for heavy Equipment and convey or and machinery in heavy industries - erection of articulated structures, braced dome sand space decks.

Unit IV
Repair Construction- Mud Jacking Grout through Slab Foundation- Micro Piling for Strengthening Floor and Shallow Profile- Pipe line Laying, Protecting Sheet Piles, Sub Grade Water Proofing, Underpinning Advanced Techniques and Sequence in Demolition and Dismantling.

Course Learning Outcomes (CLOs):

CLO-1: Analyze the skeleton structures using stiffness analysis code.

CLO-2: Fundamental to application of analysis to Engineering problems

CLO-3: Use direct stiffness method understanding its limitations

CLO-4: Apply numerical methods to solve continuum problems

References Book:

1. Jerry Irvine, “*Advanced Construction Techniques",* California Rocketry, 1984).
2. National Building Code of India, Part-IV and VII–2006.
3. Rai Mohan and Jai Singh. M.P, “*Advances in Building Materials and Construction*” CBRI Roorkee
4. SP-23(S&T)–Hand Book on concrete Mixes based on Indian standards

Text Books

5. Robert wade Brown, "*Practical foundation engineering handbook*", McGraw Hill Publications, 1995
6. Patrick Powers. J., "*Construction Dewatering: New Methods and Applications*", John Wiley and Sons 1992.

Online links for study & reference materials:

https://nptel.ac.in/courses/Civil

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPCT2 **Course Name ECO-FRIENDLY CONSTRUCTIONS**

Course Credit Hour : 3 Hour **Total Contact Hour:32**

Understand the properties of fresh and hardened concrete. 2. Know the strategies of maintenance and repair. 3. Get an idea of repair techniques. 4. Understand the properties of repair materials 5. Understand the retrofitting strategies and techniques

Course Objective:

Understand the properties of fresh and hardened concrete

Course Description:

An idea of how to optimize construction projects based on costs

Unit I Eco-friendly Planning

Energy Efficient Shelters, Housing Options Today,Site Planning and Use of On Site Resources, Smaller Houses that Utilize Space and Materials More Efficiently, Working With Nature, Better Window Planning, Balancing Energy and Aesthetic Needs.

Unit II Eco-friendly Materials

Construction materials– locally available building materials- Soil, Fly ash, Ferro cement, Lime, Fibres, Stone Dust, Red mud, Gypsum, Alternate Wood, Polymer-ADOBE, Cob Rammed Earth, Light Clay, Straw - Bale, Bamboo, Agro-Industrial Waste, Innovative Materials Developed by CBRI, SERC, Structural Properties Of Alternate Building Materials, Earthen Finishes, Earth Plasters, Earth Floors.

Unit III Cost Effective Construction Techniques

Construction Techniques- Innovative Techniques developed by CBRI, SERC for foundation, superstructure, roofing, pre-fabricated construction techniques, advantage of pre-fabrication areas where pre-fabrication can be introduced, modular contained earth, earth bag construction.

Unit IV Cost Effective Construction Equipments

Equipments- Brick moulding machine, Stablilised soil block making machine and plants for the manufacturing of concrete blocks, M.C.R. tile making machine, Ferrocement wall panel & Roofing channel making machine, R.C.C. Chaukhat making machine.

CLO-1: Analyze the Eco-friendly Planning.

CLO-2: Fundamental application of Eco-friendly Materials

CLO-3: Use direct Cost Effective Construction Equipments

References Book :

1 LynneElizabeth,CassandraAdams“AlternativeConstruction:Contemporary Natural Building Methods”,Softcover,Wiley&SonsAustralia,Limited,John,2005

2. EugeneEccli-“LowCost,Energyefficientshelterforowner&builder”,RodalePress,1976

Text Books

1 Givoni,“Man,Climate,Architecture”,VanNostrand,NewYork,1976.
2 Charles J. Kibert, Sustainable Construction: Green Building Design and delivery, John Wiley & Sons, 2005

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPE2C **Course Name REPAIRS & REHABILITATION OF STRUCTURES**

Course Credit Hour : 3 Hour **Total Contact Hour:32**

Course Objective

This subject imparts a broad knowledge in the area of repair and rehabilitation of Structures

Course Description

1. Understand the properties of fresh and hardened concrete.

2. Know the strategies of maintenance and repair.

3. Get an idea of repair techniques.

4. Understand the properties of repair materials

5. Understand the retrofitting strategies and techniques

Unit I MAINTENANCE AND REPAIR STRATEGIES

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

Unit II SERVICEABILITY AND DURABILITY OF CONCRETE

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness and cracking.

Unit III MATERIALS FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete.

Unit IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Expoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Engineered demolition techniques for dilapidated structures – case studies

Unit V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

Repairs to overcome low member strength. Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

TEXT BOOKS:

1. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 1991.
2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987

REFERENCES:

1. Shetty M.S., "Concrete Technology - Theory and Practice", S. Chand and Company, 2008.
2. Dov Kominetzky M.S., " Design and Construction Failures", Galgotia Publications Pvt. Ltd., 2001
3. Ravishankar.K., Krishnamoorthy T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.
4. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.
5. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2013

Text Book

Shetty M.S., "Concrete Technology - Theory and Practice", S. Chand and Company, 2008

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPE1C **Course name CONTRACT LAWS & REGULATIONS**
Credits: 03 **Total Contort Hour : 32**

Course objective : Knowledge: Basic and broad knowledge in business laws in management. Ability to apply concepts, principles and theories to understand simple business laws. 2. Global Perspective: Awareness of the different business laws. 3. Awareness of the global business laws and its impacts on businesses.

Course Description

Unit I
Construction contracts: Indian Contracts Act-Elements of Contracts-Types of contracts-Features Suitability-Design of Contract Documents-International contract document-Standard contract Document-Law of Torts

Unit II
Tenders: Prequalification-Bidding-Accepting-Evaluation of Tender from Technical, Contractual and commercial points of view-contract formation and interpretation-Potential contractual problems-World Bank Procedures and Guidelines

Unit III
Arbitration-Comparison of Actions and Laws-Agreements, subject matter-Violations-Appointment of Arbitrators-Conditions of Arbitrations-Powers and duties of Arbitrator-Rules of Evidence-Enforcement of Award-costs

Unit IV
Legal Requirements-Insurance and Bonding-Laws Governing Sale, Purchase and use of Urban and Rural land-Land Revenue codes- Tax Laws-Income Tax, Sales Tax, Excise and customs duties and their influence on construction costs-Local Government Laws for Approval
Labour Regulations-Social Security-Welfare Legislation-Laws relating to wages and Bonus, Labour Administration- Insurance and Safety Regulations-Workmen's Compensation Act.

CO1. Explain the concepts in business laws with respect to foreign trade
CO2. Apply the global business laws to current business environment
CO3. Analyse the principle of international business and strategies adopted by firms to expand globally
CO4. Integrate concept of business law with foreign trade

References Book :
1. Jimmie Hinze, "*Construction Contracts* ", 2nd Edition, McGraw Hill, 2001.
2. Joseph T. Bockrath, " *Contracts and the Legal Environment for Engineers and Architects* ", 6th Edition,McGraw Hill, 2000.
3. Richard Hudson Clough, Glenn A. Sears, "*Construction Contracting*", J. Wiley, 21-Mar-2005

Text Book :
4 Gajaria G.T., "*Laws Relating to Building and Engineering Contracts in India* ", M.M. Tripathi PrivateLtd.,Bombay, 1982.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPCL1 **Course Name : ADVANCED CAD LAB**

Course Credits hours : 1.5 **Total Contoct Hour 3**

List of Experiments

1. Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project.
2. Design of a simple equipment information system for a construction project.
3. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
4. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.

List of Equipments / Softwares / Tools Requirements

1. MS OFFICE
2. MS PROJECT
3. PRIMAVERA
4. REVIT
5. AutoCAD 2012
6. PERT MASTER

SEMESTER-II

Course Code: CPCT3 **Course Name:** CONSTRUCTION PLANNING, SCHEDULING & CONTROL

Credits: 03 **Total Contact Hour32**

Course Objectives

The objectives of this course are to:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Description

This course will provide a general introduction to project management. This This course will equip the students to various feasibility analyses – Market, Technical, Financial and Economic.

Unit I

Construction Planning - Basic Concepts in the Development of Construction Plans-Choice of Technology and Construction Method- Defining Work Tasks-Definition-Defining Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.

Unit II

Scheduling Procedures And Techniques - Relevance Of Construction Schedules-The Critical Path Method-Activity Float And Schedules-Critical Path Scheduling For Activity-On-Node And With Leads, Lags And Windows-Resource Oriented Scheduling-Scheduling With Resource Constraints And Precedence-Use Of Advanced Scheduling Techniques-Scheduling With Uncertain Durations-Calculations For Monte Carlo Schedule Simulations-Crashing And Time/Cost Tradeoffs

Unit III

Cost Control Monitoring and Accounting- the Cost Control Problem-The Project Budget Forecasting for Activity- Cost Control Financial Accounting Systems and Cost Accounts-Control of Project Cash Flows-Schedule Control-Schedule and Budget Updates-Relating Cost and Schedule Information.

Unit IV

Organization and Use Of Project Information- Types of project information-Accuracy and Use of Information-Computerized organization and use of Information-Organizing information in databases-Relational Model Of Data Bases-Other conceptual Models of Databases-Centralized databases Management systems-Databases and application programs-Information transfer and Flow.

Course Learning Outcome

CLO1 .Understand project characteristics and various stages of a project.

CLO 2. Understand the conceptual clarity about project organization and feasibility analyses

CLO3 : Organization and Use Of Project Information

CLO4: Apply Cost Control Monitoring

References:

1. Calin M. Popescu, ChotchaiCharoenngam, " *Project planning, Scheduling and Control in Construction:AnEncyclopedia of Terms and Applications* ", Wiley, New York, 1995.
2. Chris Hendrickson and Tung Au, " *Project Management for Construction – Fundamentals Concepts forOwners "*, Engineers, Architects and Builders, Prentice Hall, Pitsburgh, 2000.
3. Moder.J., C.Phillips and Davis, "*Project Management with CPM* ", PERT and Precedence Diagramming,VanNostrand Reinhold Co., Third Edition, 1983.
4. Willis., E.M., " *Scheduling Construction projects* ", John Wiley and Sons 1986.
5. Halpin,D.W., " *Financial and cost concepts for construction Management ",* John Wiley and Sons, NewYork, 1985.

Text Book

Chitkara, K.K. "Construction *Project Management Planning* ", Scheduling and Control, Tata McGrawHillPublishing Co., New Delhi, 1998.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPCT4 **Course name: CONSTRUCTION PERSONNEL MANAGEMENT**

Credits: 03` **Total Contact hour 32**

Course Objective

To create a complete understanding on quality planning, quality assurance, quality control and safety management Correlates to program outcome Know the Quality plan and Quality Management Guidelines

Course Description : To create a complete understanding on quality planning, quality assurance, quality control and safety management

Unit I Manpower Planning

Manpower Planning, Organizing, Staffing, directing and Controlling-Personnel Principles-case studies.

Unit II Organization

Organization-Span of control-Organization charts-Staffing plan-Development and Operation of Human resources- Managerial Staffing-Recruitment-Selection-Placement, Training and Development.

Unit III Human Behaviour

Introduction to the Field Of Management-basic individual psychology-motivation-job design and performance management-Managing groups at work-self managing work teams-Inter group behavior and conflict in organizations-Leadership-Behavioral aspects of decision-making; and communication for people management.

Unit IV Management and Development Methods

Compensation-Wages and Salary, Employee Benefits, employee appraisal and assessment-Employee services- Safety and Health-Discipline and Discharge-Special human resource problems, Performance appraisal-Employee Hand Book And Personnel Manual-Job descriptions and organization structure and Human relations-Productivity of Human resources.

Course Outcome

CLO 1. Know the Quality plan and Quality Management Guidelines

CLO2 Understand the Quality system and standard Documents and Quality related training

CLO3 Know the quality planning, Contract and construction programming, Inspection procedures, Processes and products

CLO4 Know the quality assurance, appraisals and quality control by reliability testing

CLO5 Understand how the quality techniques can be improved.

References:

1. Josy. JFamilaro, “Handbook *of Human Resources Administration* ", McGraw Hill International Edition, 1987.
2. Justin Gooderl Longenecker, Charles D. Pringle, “Management " C.E. Merrill, 1981.
3. R.S .Dwivedi, *“Human Relations and Organizational Behaviour*", B.H - 1987.
4. Shamil Naoum, “*People and Organizational Management in Construction*”, Thomas Telford,2001
5. Stephen Bach & Keith Sissons,”*A Comprehensive Guide to Theory and Practice”*, John Wiley &Sons,2000.
6.Andrew Dainty, Martin Loose more, ”Human Resource Management in Construction Projects”, Routledge,2012.

Text Book

1. Carleton Counter II and Jill Justice Coulter, "*The Complete Standard Hand Book of Construction Personnel Management* ", Prentice Hall, Inc., New Jersey, 1989.
2. Memoria, C.B., *"Personnel Management* ", Himalaya Publishing Co., 1992.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPE3C Course Name CONSTRUCTION ECONOMICS AND FINANCE MANAGEMENT

Course Credit Hours: 03 **Total Contact Hour 32**

Course Objective: To study the role & methods of economics & finance concepts applied to construction business.

Course Description (1) Economics - Market demand and supply

(2)- Construction of economics - Form and Functional designs-Construction workers –

(3) Basics of accounting - Analysis of financial statement

Unit I Economics

Role of Civil Engineering in Industrial Development-Advances in Civil Engineering and engineering economics- Support matters of Economy as related top Engineering-Market demand and supply-Choice of technology- Quality control and Quality Production-Audit in economic law of returns governing production

Unit II Construction of economics

Construction development in housing, Transport and other infrastructures-Economics of Ecology, environment, energy resources-Local material selection-Form and Functional designs-Construction workers-Urban problems-Poverty-Migration-Unemployment-pollution.

Unit III Financing

The need for financial management-Types of financing-Short term borrowing-Longterm borrowing-Leasing - Equity financing-Internal generation of funds-External commercial borrowings-Assistance from Government Budgeting support and International finance corporations-Analysis of financial statements-Balance sheet-Profit and loss account-Cash flow and fund flow analysis-Ratio analysis-Investment and financing decision-Financial control-Job control and Centralized management

Unit IV Accounting Method

General Overview-Cash basis of an accounting-Accrual basis of accounting-Percentage completion method-Completed contract method-Accounting for Tax reporting purposes and financial reporting purposes.

Lending to Contractors- Loans to Contractors-Interim Construction Financing-Security and RiskAspects

CLO1 understanding the underlying principles and concepts in construction economics and finance.

CLO2 Understanding **Accounting Method**

CLO3 Understanding Financing

References Book

1. Prasanna Chandra, "*Projects - Planning Analysis Selection Implementation & Review* ", FourthEdition, Tata McGraw Hill Publishing Co., Ltd, New Delhi, 1995.

2. Kwaku A., Tenah and Jose M. Guevera, "*Fundamental of Construction Management andOrganization* ", Prentice Hall of India, 1995 .

Text Book

1 Halpin, D.W., " *Financial and cost concepts for construction Management* ", John Wiley andSons,New York, 1985

https://nptel.ac.in/courses/105/103/105103023/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPE4CCourse Name: QUALITY CONTROL & PROJECT SAFETY MANAGEMENT

Credits: 03 **Total Credit hour 32**

Course Objective To study the concepts of quality assurance and control techniques in construction.
Course Description : (1) Quality Management **-** Contract and construction programming –
(2) Total Quality Management
(3) Quality Control - Quality Assurance

Unit I Construction Organization

Types of Organization-Inspection, Control and enforcement-Quality Management Systems and Method-Responsibilities and authorities in Quality assurance and Quality control-Architects, Engineers, Contractors, and Consultants, Quality circle

Quality Management: Quality policy, Objectives and methods in construction industry-Consumersatis faction-Ergonomics-Time of Completion-Statistical Tolerance-Taguchi's concept of quality Codes and standards-Documents-Contract and construction programming-Inspection procedures Processes and products-Total QA / QC Programme and cost implication

Unit II Quality Assurance and Control

Objectives-Regularity agent-Owner, Design, Contract And Construction Oriented Objectives, Methods-Techniques and Needs Of QA/QC-Different Aspects of Quality-Appraisals, Factors Influencing Construction Quality-Critical, Major Failure Aspects And Failure Mode Analysis.

Standardization - Selection Of New Materials-Influence Of Drawings, Detailing And Specification Based On Codal Provisions.

Unit III Construction Accidents

Injury And Accidents-Definitions-Unsafe Act –Unsafe Condition Causes, Investigations And Prevention Of Accidents, Hazards, Type Of Industrial Hazards-Nature, Causes And Control Measures, Hazard Identifications And Control Techniques HAZOP , FMEA, FMECA. -Cost of Construction Injuries-Legal Implications

Safety Programmes- Introduction to the Concept of Safety- Need- Safety Provisions in the Factory Act-Laws related to the Industrial Safety-Measurement Of Safety Performance, Safety Audit, Problem Areas In Construction Safety-Elements of an Effective and Safety Programme-Job site Safety assessment- Safety Meetings-Safety Incentives

Unit IV Safety Organization

Safety Policy, Safety Record Keeping, Safety Culture-Safe Workers-Safety and First Line Supervisors-Safety and Middle Managers-Top Management Practices, Company Activities and Safety-Safety Personnel-Sub contractual obligation, Project Coordination and Safety Procedures

Course learning Outcomes
CLO-1 Apply Concept of Quality Managent
CLO-2 Understanding Safety Programmes

References:

1. Kwaku A., Tenah and Jose M.Guevera, “*Fundamental of Construction Management and Organization* ",Prentice Hall of India, 1995.
2. Juran Frank, J.M. and Gryna, F.M. " *Quality planning and Analysis* ", Tata McGraw Hill, 1982.
3. Hutchins. G., “ISO 9000 ", Viva Books, NewDelhi, 1993.
4. Clarkson H. Oglesby, “*Productivity Improvement in Construction* ", McGraw Hill 1989.
5. John L.Ashford, " *The Management of Quality in Construction* ", E & F.N Spon, New York, 1989.
6. Steven McCabe, “Quality *Improvement Techniques in Construction* ", Addisson Wesley Longman Ltd.,England, 1998.
7. Jimmy W.Hinze, “*Construction Safety* ", Prentice Hall Inc., 1997.

Text book

(1) James, J.O Brien, “*Construction Inspection Handbook - Quality Assurance and Quality Control* ", VanNostrand, New York, 1989

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

.

Course Code: CPCL3 **Coures Name: COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING**

Credits: 02 **Total Credit hours 20**

Course Objective (1)To study and understand the hardware and software requirements of computer, programming, optimization techniques, inventory models and scheduling techniques applied to construction engineering.
(2) To give knowledge about computer applications in construction engineering
Course Description: Understand the concept of Monitoring and controlling.

Unit I Software Applications
Introduction To BIM Software Application To Enhance Efficiency During And Post Construction. Applications like Determination of Quantities of Items and Material Inventory, To Build a Building Virtually Prior to Building It Physically, Work Out Problems, Anticipation And Ease Of Project Delivery, The Overall Safety Of The Project.

Unit II Optimization Techniques
Linear, Dynamic and Integer Programming- Branch and Bound Techniques-Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems - Deterministic and Probabilistic Inventory Models -Software Development

Unit III Scheduling Applications
Introduction to Software like Primavera -P6 / MSProject / Suretrak - For schedule development and tracking of it; Pro log-Data Management - RFI's [Request for Information], Submitting -Product Data, Punch list etc.; JDE [JDEd wards] - Financial Management -For use of tracking and developing the cost reports and issuing the change orders.

Unit IV Scheduling Applications
PERT and CPM - Software Development Navis works In this software 3DAutoCAD / Revit model can be imported with a project schedule to review the progress of the Project

CLO - 1 : To understand the optimization techniques in construction engineering.

CLO - 2 : To clearly explain the developing application with files and database software.

CLO- 3 : To understand the Software applications , Resource Allocation ,Over Allocation, Resource Leveling and Smoothening, Preparation of Detailed Reports.

CLO – 4 : To understand about the resource allocation and leveling

References Book:

1. BilyE.Gillet.,"*IntroductiontoOperationResearch*"-AComputerOrientedAlgorithmicApproach,TataMcGrawHill,1990.
2. Paulson,B.R.,"*ComputerApplicationsinConstruction*",McGrawHill,1995.
3. Feigenbaum.,L.,"*ConstructionSchedulingWithPrimaveraProjectPlanner*",PrenticeHallIn

Text book

1. Feigenbaum.,L.,“*ConstructionSchedulingWithPrimaveraProjectPlanner*",PrenticeHallIn

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

SEMESTER-III

Course Code: CPE5C Course Name : GIS IN CONSTRUCTION ENGINEERING AND MANAGEMENT

Course Credits Hours: 03 **Total Credit Hours : 32**

Course Objective: To introduce the students to the basic concepts and principles of various components of remote sensing. • To provide an exposure to GIS and its practical applications

Course Description

This Course is Application of GIS in CONSTRUCTION ENGINEERING

Unit I Mapping

GIS-Definition-Components of GIS-Maps-Definition-Types of Maps-Characteristics of Maps-Map Projections--Hardware, Software and Organizational Context-GIS software

Unit II DataTypes

Spatial and Non-Spatial – Spatial Data- Points, Lines and areas – Non-spatial data-Nominal, Ordinal, Interval and Ratio-Digitizer- Scanner-Editing and Cleaning-Georeferenced data

Unit III DataStructure

Raster and Vector Data Structure- Raster data storage- Run length, Chain and Block Coding-Vector Data Storage- Topology- Topological Models- Arc Node Structure- Surface Data- DEM- Grid DEM and TIN structure- Applications of DEM

Unit IV DataMeasurement

Reclassification- Measurement- Buffering- Overlaying- SQL for Queries- Neighborhood and zonal operations- Data Quality - Components of data quality- Sources of errors in GIS-Meta data Output-Maps, Graphs, Charts, Plots, Reports- Printers- Plotters- Fields of application- Natural Resource Management, construction management- Parcel based, AM/FM applications examples- Case study

Course Learning Outcome

CLO –1: To clearly explain the GIS software.

CLO –2: To understand the DataTypes, Spatial and Non-Spatial.

CLO –3: Elaborate the concept on Raster and Vector Data Structure and its application.

CLO –4: To understand the Data Quality of GIS and its components.

CLO –5: To clearly explain the concept of Maps, Graphs, Charts, Plots, Reports – Printers, Plotters.

References

1. BurroughP.A.,*PrinciplesofGISforLandResourcesAssessment*,OxfordPublication,1998
2. RobertLauriniandDerekThompson,*FundamentalsofSpatialInformationSystems*,AcademicPress,1996
3. AnjiReddy,*RemoteSensingandGeographicalInformationSystems*,BSPublications2001

4. SrinivasM.G.(Editedby),*RemoteSensingApplications*,NarosaPublishingHouse,2001
5. Rhind, D *Understanding of GIS, The ARC/INFOMethod*,ESRIPress.1990

Text books

Kenneth C Laudon and Jane Price Laudon, Management Information Systems - Organisation and Technology, 11th Edition, Prentice Hall, 2008.

2. Gordon B. Davis, Management Information System: Conceptual Foundations, Structure and Development, 21st Reprint, McGraw Hill, 2008

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

SEMESTER -IV

DISSERTATION

Course Code: MTC04 **Credits: 16**

The term work under this, submitted by the student shall include –
1. Work diary maintained by the student and counter signed by his guide.
2. The contents of work diary shall reflect the efforts taken by candidate for
(a) Searching the suitable project work
(b) Visits to different factories or organizations
(c) Brief report of journals and various papers referred
(d) Brief report of web sites seen for project work
(e) The brief of feasibility studies carried to come to final conclusion
(f) Rough sketches
(g) Design calculation etc. etc. carried by the student.
The student has to make a presentation in front of panel of experts in addition to guide as
The dissertation submitted by the student on topic already approved by university authorities on the basis of initial synopsis submitted by the candidate shall be according to following guidelines –
Format of dissertation report –
The dissertation work report shall be typed with double space on A4 bond paper. The total number of pages shall not be more than 150 and not less than 60. Figures, graphs, annexures etc. be added as per requirement. The report should be written in the following format.
1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures / photographs / graphs / tables
5. Abbreviations
6. Abstract / final synopsis
7. Contents
8. Text with usual scheme of chapters
9. Discussion of the results and conclusion
10. Bibliography (The source of illustrative matter be acknowledged clearly at appropriate place) decided by department head.

ELECTIVE-IV

Course Code : CPE4C1 **Course Name: ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION**

Course Credit hour 3 **Total Credit hour 30**

Course Objective

To clearly understand the causes of global warming.

To develop idea of weather and climate.

To understand how the global warming have impacts on people and nature.

Course Description: To understand various Energy Conservation Tech in Building Construction

Unit I Energy

Fundamentals of Energy- Energy production systems-Heating, Ventilating and Air conditioning Solar Energy and conservation-Energy Economic Analysis-Energy Conservation And Audits Domestic Energy Consumption-Savings-Primary Energy use in Buildings-Residential Commercial-Institutional And Public Buildings.

Unit II Energy

Energy and resource conservation-Principles, Design of green buildings-rating systems-LEED Standards-Evaluation Tools for Building Energy-Embodied and Operating Energy-Peak demand Comfort and Indoor Air Quality-Visual and Acoustical Quality-Energy Efficient Design Strategies Contextual factors-Longevity and Process Assessment

Unit III Energy Efficiency

Energy in Building Design-Energy Efficient and Environmental Friendly Building- Climate, Sun and solar radiation-Psychometrics-Passive Heating and Cooling Systems- Energy Audit-Types of Energy audit-Analysis of results-Energy flow diagram-Energy consumption/Unit production Identification of wastage-Priority of conservative measures-Maintenance of Energy Management Programme

Unit IV Energy Management

Energy Management of Electrical Equipment-Improvement of Power Factor-Management of Maximum Demand- Energy Savings in Pumps-Fans-Compressed Air Systems-Energy Savings in Lighting Systems-Air Conditioning Systems-Applications-Facility Operation And Maintenance Facility Modifications-Energy Recovery Dehumidifier-Water Heat Recovery-Steam Plants and Distribution Systems-Energy Savings In Pumps-Fans-Compressed air systems-Applications

Course Learning Outcomes

CLO –1: To understand the physical basis of natural greenhouse effect, including the meaning of the term radioactive forcing.

CLO –2: To know something of the way various human activities are increasing emissions of the natural greenhouse gases, and are also

CLO –3: Climate change, and the extent of anthropogenic influence.

CLO –4: To clearly explain the mcontributing to sulphate aerosols in the troposphere

References:

1. Moore F., " *Environmental control systems* ", McGraw Hill, Inc., 1994.
2. Brown, G.Z, Sun, " *Wind and Light: Architectural design Strategies* ", John Wiley & Sons., 1985.

3. Cook, J, " Award - *Winning Passive Solar Design* ", McGraw Hill, 1984.

Text book

Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code : CPE4C2 **Course Name : Building Service**

Course Credit Hour **Total Credit hour 30**

Course Objectives: To study and understand the construction system integration, environmental factors such as the quality of air, acoustic control; services such as air conditioning , maintenance and safety systems.

Course Outcome: Understand Necessity of Building service s

Unit I Water Supply & Sewage System

Water quality, Purification and treatment- water supply systems-distribution systems in small towns -types of pipes used- laying jointing, testing-testing for water tightness plumbing system for building-internal supply in buildings- municipal bye laws and regulations - Rain Water Harvesting - Sanitation in buildings- -pipe systems- storm water drainage from buildings -septic and sewage treatment plant - collection, conveyance and disposal of town refuse systems.

Unit II Electrical System

Types of wires , wiring systems and their choice -planning electrical wiring for building -main and distribution boards -transformers and switch gears -modern theory of light and colour -synthesis of light -luminous flux -candela- lighting design-design for modern lighting.

Unit III Ventilation

Ventilation and its importance-natural and artificial systems-Window type and packaged air-conditioners-chilled water plant -fan coil systems-water piping -cooling load –air conditioning systems for different types of buildings -protection against fire to be caused by A.C .systems.

Unit IV Safety Against fire in building

Safety-Ability of systems to protect fire-Preventive systems-Fire escape system design-Planning for pollution free construction environmental-Hazard free Construction execution safety regulations-NBC-planning considerations in buildings like Non combustible materials, construction, staircases and A.C. systems-heat and smoke detectors-dry and wet risers-Automatic sprinklers - Capacity determination of OHT and UGT for firefighting needs.

Course learning Outcomes

CLO –1: To study and understand the construction system integration,
CLO –2: To understand the environmental factors
CLO –3: To expose the building service conditions
CLO –4: To study about maintenance and safety systems in construction.
CLO –5: To know the requirement of various structural systems in construction.

References:

1. E.R.Ambrose, "*Heat Pumps and Electric Heating*", John and Wiley and Sons, Inc., New York, 1968.
2. *Handbook for Building Engineers in Metric systems*, NBC, New Delhi, 1968.
3. William T. Mayer, *Energy Economics and Build Design*, McGraw-Hill Book, Company, 1983.
4. William H.Severns and Julian R.Fellows, "*Air-conditioning and Refrigeration*", John Wiley and Sons,London, 1988.

5. A.F.C. Sherratt, “*Air-conditioning and Energy Conservation*”, The Architectural Press, London, 1980.
6**.** E.C. Butcher and A.C. Parnell, Designing *for Fire Safety*, John Wiley and Sons, 1993.

Text book

1 E.R.Ambrose, “*Heat Pumps and Electric Heating*”, John and Wiley and Sons, Inc., New York, 1968.
2. *Handbook for Building Engineers in Metric systems*, NBC, New Delhi, 1968.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE- V

Course Code: CPE5C1 **Course Name :** MODERN CONSTRUCTION MATERIALS, METHODS AND EQUIPMENTS

Course Credit Hour 3 hr Total Contact hour 30

Course Objectvie : To study and understand the various safety concepts and requirements applied to construction projects and to study the of construction accidents, safety programmes, contractual obligations & design for safety.

To understand the designing for safety

Unit I Modern Construction Materials

Study of Advance Building Materials like, aluminium, glass, fabric, various types of finishes & treatments, Construction chemicals–sealants, engineering grouts, mortars, admixtures and adhesives

Unit II PolymersinCivilEngineering

Structural Plastics and Composites- Polymer Membranes- Coatings- Adhesives, Non-Weathering Materials- Flooring and Façade Materials- Glazed Brick, Photo Catalytic Cement, Acid Etched Copper and Composite Fiber

Metals- Metals And Special Alloys of Steel- Water Jet Cut Stainless Steel, Mill Slab Steel, Tension Rods Assemblies And Cast Iron, Heat Treatment In Steels, Tendons.

Unit III Construction methods

Precast Flat Panel System, 3d Volumetric Construction, Tunnel Boring Methods, And Precast Foundations. Fabrication of Pre-Cast and Pre-Stressed Components, Reinforcing Steel: Types, Bending, Placing, Splicing and Spacing, Tendons-Soil Improvement-Mechanical, Thermal and Chemical.

Unit IV Construction Equipments

Equipment for Excavating, Dredging, Trenching, Tunneling, Drilling, Blasting-Equipment for compaction-Erection Equipment-Types of pumps used in construction- Equipment for Dewatering and Grouting Foundation and Pile Driving Equipment, Fork lifts and related Equipment-Portable Material-Conveyors-Hauling Equipment

Course Outcomes

CLO –1: To understand the construction accidents and Legal Implications.

CLO –2: To clearly explain the Elements of an Effective Safety Programme.

References:

1. ShanSomayaji,"CivilEngineeringMaterials",2ndEdititon,PrenticeHallInc.,2001.
2. Mamlouk,M.S.andZaniewski,J.P.,"MaterialsforCivilandConstructionEngineers", Prentice H 1999.
3. Derucher,K.Korfiatis.G.andEzeldin,S.,"MaterialsforCivilandHighwayEngineers", Prentice Hall Inc., 1999.4thEdition
4. Peurifoy,R.L.,Ledbetter,W.B.andSchexnayder,C.,“ConstructionPlanning,Equipmentand Methods",5th Edition, Mc Graw Hill,Singapore,1995.

5. SharmaS.C.“ConstructionEquipmentandManagement",KhannaPublishersNewDelhi, 1988.
6. Deodhar,S.V.“ConstructionEquipmentandJobPlanning",KhannaPublishers,NewDelhi,198
7. Dr. MaheshVarma,“ConstructionEquipmentanditsPlanningandApplication", Metro-politan Book Company, New Delhi-,1983.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: CPE5C2 Course Name : RESOURCE MANAGEMENT & CONTROL IN CONSTRUCTION

Course Credit Hour 3 hr Total Contact hour 30

Course Objectives To study the basic knowledge on the principles and functional design of buildings

- To identify the right codes and standards used for the buildings
- To understand the concept of buildings relating to water supply, sanitary, electrical, and also intelligent buildings

Course Description

To understand concept of RESOURCE MANAGEMENT & CONTROL IN CONSTRUCTION

Unit I RESOURCE PLANNING

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

Unit II LABOUR MANAGEMENT

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

Unit III MATERIALS AND EQUIPMENT

Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

Unit IV TIME MANAGEMENT

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control.

Unit VRESOURCE ALLOCATION AND LEVELLING

Time -cost trade off, Computer application – Resource leveling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management

Reference book

1. G.M.Fair,J.C.Geyer and D.Okun, "Water and waste Engineering" ,Vol.II,John Wiley &sons,Inc.,New York. 1968
2. R.G.Hopkinson and J.D.Kay , "The Lighting of buildings" ,Faber and Faber,London, 1969
3. Hand book for Building Engineers in Metric systems,NBC, New Delhi, 1968

Text book

William H.Severns and Julian R.Fellows, "Air conditioning and refrigeration" ,John Wily and sons, London,1988.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1 - 05%

Assignment-2 - 05%

Assessment-3(Midexam) - 20%

Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Environmental Engineering

se Curriculum

FOR M.TECH-ENVIRONMENTAL ENGINEERING COURSE
(Effective from Academic session 2019-2020)

Introduction-

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Master in Environmental Engineering aims to build in students competent business acumen through advanced study of Environmental Chemistry, Environmental Microbiology, Computational Methods, Water Supply Management, Waste Water Management, Municipal Water Treatment, Industrial Water Treatment, Applied Statistics for Environmental Engineering, Environmental Impact Assessment, Industrial Pollution Prevention, Air Pollution Control, Solid and Hazardous Waste Management, Remote Sensing and GIS Application, Ecological Engineering, ,later allowing them to specialize in a chosen area. M.Tech. Environmental Engineering curriculum involves intensive study, culminating with the completion of a research-based dissertation. One of the principal objectives of the course is to prepare students for improving the environment, as also for pursuing advanced research in the discipline. The course's curriculum integrates theoretical and practical components of the study. M.Tech in Environmental Engineering is an academic programme of the duration of two years which integrates the field of public sector from municipal public works. The programme primarily lays emphasis onthe basics of Nature Sustainability and their management

Program Educational Objectives (PEOs)

The Programme of Environmental Engineering has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

PEO1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in built environment issues through new ideas and knowledge.

PEO2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.

PEO3: Provide sound theoretical and practical knowledge of Civil Engineering, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.

PEO4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.

PEO5: Ability to engage with other socio- economic activity and perform standard competencies at national and local practice of architecture with the integration of other engineering disciplines

Programme specific outcome (PSO)

PSO-1. Realize the seriousness of various air pollutants and understand how they are getting dispensed in the atmosphere due to meteorological parameter.

PSO-2 Design water conveyance system and water transmission mains. PSO-3 Gain knowledge on

sewerage system and to design sanitary sewer.PSO-4 Get acquainted with computer applications

in water and sewage conveyance.

PSO-5 Develop knowledge on different waste processing technology and energy recovery. PSO-6 Be aware of waste

sampling and source reduction of wastes.

PSO-7 In laboratory, various parameter like PH, Total Solids, Iron and manganese, BOD,COD and chloride

,Sulphate and dissolved oxygen in water and waste water are performed. They will be able to analysis air sample and soil sample. Also used GIS software for survey calculation and remote sensing data.

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO**1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO**2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO**3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO**4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO**5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO**6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO**7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO**8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO**9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO**10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO**11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO**12**. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of M.Tech:

- Every semester shall offer a minimum of **16 credits** and a maximum of 18 **credits**.
- Credits for the Project or Thesis can vary from 10 to 16.
- The total number of credits for the M. Tech Degree Course could vary from a **minimum of 68** credits to a **maximum of 78** credits.
- All courses of study put together would engage the students for a **minimum of 14 periods** or hours of study a week and a **maximum of 20 periods** or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the M.Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
    (i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
    (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate‘s proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits	Percentage
1	Humanities and Social Sciences including Management courses	0	
2	Basic Science courses	0	
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	10	
4	Professional core courses	9	
5	Professional Elective courses relevant to chosen specialization/branch	18	
6	Open subjects – Electives from other technical and /or emerging subjects	3	
7	Project work, seminar and internship in industry or elsewhere	28	
8	Mandatory Courses	0	
		68	

**Minor variation is allowed as per need of the respective disciplines.*

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (158 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16

Course coding system

Every course coded as follows:

BSC : Basic Science Courses
ESC : Engineering Science Course
MC : Mandatory Courses
HSMC : Humanities and Social Sciences including Management
PCC : Program core courses
PEC : Program Elective courses
OEC : Open Elective courses

Master of Technology-Environmental Engineering(CE)

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
EPCT1	Advance Environmental Engineering	3	0	0	40	60	100	3
EPCT2	Advance Engineering Hydrology	3	0	0	40	60	100	3
EPE1E	Program Elective-1 (1) Air Quality Modeling & Management (2) Energy and Environment (3) Environment Toxicology	3	0	0	40	60	100	3
EPE2E	Program Elective-2 (1) Soil and Groundwater Contamination (2) Modelling and Simulation (3) Management in wastage	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
MAC0E	Audit Course-1	2	0	0	40	60	100	0
EPCL1	Advance Environmental Engineering Lab-1	0	0	4	40	60	100	2
EPCL2	Environmental Monitoring laboratory Lab	0	0	4	40	60	100	2

Total							800	18
Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
EPCT3	Unit Process	3	0	0	40	60	100	3
EPCT4	Remote Sensing & GIS	3	0	0	40	60	100	3
EPE3E	Program Elective-3 (1) Environmental Impact (2) Environmental Impact Assessment and Audit (3) Environmental Systems	3	0	0	40	60	100	3
EPE4E	Program Elective-4 (1) Industrial Waste Water Treatment (2) Fundamentals of Sustainable Development (3) Integrated Watershed Management	3	0	0	40	60	100	3
MAC0E	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
EPCL3	Remote Sensing & GIS Lab	0	0	4	40	60	100	2
EPCL4	Water Quality Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge MAC04.
Value Education
MAC05. Constitution of India MAC06.
Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
EPE5E	Program Elective-5 (1) Solid and Hazardous Waste Management (2) Environment Geotechnology (3) Rural Water Supply and Sanitation	3	0	0	40	60	100	3
MOE0E	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks (ISA)**	**Marks (ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective
MOE01. Business Analytics MOE02.
Industrial Safety MOE03. Operations
Research
MOE04. Cost Management of Engineering Projects MOE05.
Composite Materials
MOE06. Waste to Energy

Semester	**Credits**		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16

DETAILED 2-YEAR CURRICULUMCONTENTS

Postgraduate Degree in Engineering &Technology

BRANCH/COURSE: Environmental Engineering

SEMESTER I
(1)

Course Code: EPCT1
Course Name: ADVANCE ENVIRONMENTAL ENGINEERING
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To provide an overview of both the theoretical and practical aspects of conventional and advanced water technology for surface water treatment.
- Select an appropriate treatment process for a specific application, and be able to identify appropriate pre-treatment and post treatment schemes, and cleaning protocols for these processes.

Course Description:
To evaluate the coventinal waste water and the efficency of particals satlements and stokes law.
Course Contents:
UNIT -I: Conventional water and waste water treatment methods, their capabilities and limitations, need for advanced treatment of water and waste water, Advanced water treatment- Iron and manganese removal, colour and odour removal, Activated carbon treatment, chlorination of waste water, Pure oxygen systems, Multistage treatment systems

UNIT- II: Methods for the removal of heavy metals, oil and refractory organics, Flotation: Objective, Types of flotation systems, Design considerations, Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances**,** Gas transfer: Aeration systems

UNIT- III: Advanced waste water treatment- Carbonate balance for corrosion control and modern methods and fluoride removal**,** Membrane filtration: Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration, Ion exchange and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes.

UNIT- IV: Microbial growth kinetics, Modeling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and denitrification, Nutrient control in effluents, Nitrogen and phosphorus removal methods including biological methods
Anaerobic sludge blanket processes, Design considerations for Upflow Anaerobic Sludge Blanket process (process options, components influence process design).

UNIT- V: Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:
Upon successful completion of the course, the students will be able to
CLO-1: Depth knowledge of physical chemical unit proce
CLO-2: Candidate should be able to use skills to perform research at a higher level.

TEXT BOOKS:

1. Wastewater Engineering, Treatment and Reuse, Metcalf & Eddy by Inc. 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
2. Biological Processes Design for wastewaters by Benefield, L.D. and Randall C.W., Prentice-Hall, Inc. Eaglewood Cliffs, 1982.
3. Biological wastewater treatment: Theory and Applications by Grady Jr. C.P.L and Lin H.C. Marcel Dekker, Inc New York, 1980.

Reference Books:

4. Environmental Engineering by H.S. Peavy, D.R. Rowe and George Tchobanoglous, McGraw- Hill Company, New Delhi, 1995.
5. Industrial Water Pollution Control by Eckenfelder, W. W., Mc, Graw-Hill, 1999.

Wastewater Treatment for Pollution Control by Arceivala, S.J., McGraw-Hill, 1998.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER I
(2)

Course Code: EPCT2 **Course Name: ADVANCE ENGINEERING HYDROLOGY**
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To study occurrence movement and distribution of water that is a prime resource for development of a civilization..
- To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.
- To know the basic principles and movement of ground water and properties of ground water flow.

Course Description: To calculate hygrometry and computation of peak flow and to draw a pine line with hardy cross method.

Course Contents
Module -I: Introduction; Historical background, hydrological cycle, hydrologic problems, water balance.
Module -II: Precipitation: Definitions, types, forms, measurement-network design, non recording and recording(automatic) precipitation gauge. Analysis of data, supplementing missing data, consistency of record, hyetograph, mass curve analysis, depth areas duration analysis, rainfall frequency analysis, station year method.
Module -III: Infiltration: Capacity, rates and indices, factor affecting, measurement of infiltration, estimation of infiltration capacity from hydrograph analysis.
Module –IV: Hygrometry: Measurement of discharge, selection of site for stage and discharge measuring station non recording and recording gauges, accuracy and frequency of observe data, discharge measurement by area velocity method and slope area method, chemical method.
Module –V: Runoff: Runoff, runoff cycle, component of runoff, factor affecting runoff, storage effect of runoff from snow melt, estimation of average monthly and annual runoff, rainfall- runoff relationship.
Module –VI: Hydrograph and its components: master recession curve, base flow and its separation, unit hydrograph theory and its application for isolated and complex storms, synthetic unit hydrograph, S- curve, unit hydrograph of varied durations, instantaneous unit hydrograph, conceptual models.
Module –VII: Computation of peak flow: Rational and empirical relationships, flood frequency analysis, Recurrence interval design flood.
Module –VIII:Flood routining: Routing through reservoirs and channels, graphical methods.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1** Provide a background in the theory of hydrological processes and their measurement
- **CLO-2** Apply science and engineering fundamentals to solve current problems and to anticipate, mitigate and prevent future problems in the area of water resources management
- **CLO-3** An ability to manipulate hydrological data and undertake widely-used data analysis.
- **CLO-4** a systematic understanding of the nature of hydrological stores and fluxes and a critical awareness of the methods used to measure, analyze and forecast their variability; and the appropriate contexts for their application.
- **CLO-5** Can define the key components of a functioning groundwater, can determine the main aquifer properties – permeability, transmissivity and storage Identify geological formations capable of storing and transporting groundwater.

Text Books & Refrences:
Ven-Te chow, David R. Maidment, Larry W. Mays; Applied hydrology Mc Graw Hill Publications, 1995.
Vijay P. singh; Elementry Hydrology, Prentice hall of india, 1994.
Web Materials:
1. http://nptel.iitm.ac.in
2. http://www.groundwatermanagement.org
3. http://www.uiowa.edu

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER I
(Lab 1)

Course Code: EPCL2 **Course Name: ADVANCE ENVIRONMENTAL ENGINEERING LAB**
Course Credit Hour: 2hr **Total Contact Hour:** 20hr

Course Objective:

- To introduce students to how the common environmental experiments relating to water and wastewater quality are performed.
- This course will help students know which tests are appropriate for given environmental problems, statistically interpret laboratorial results and write technical reports, and apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.

Course Description: BOD and COD and other parameters will perform in lab.
Course Contents

- BOD and BOD rate constant determination
- COD Determination
- Determination of various forms of Phosphates
- Determination of Nitrogen Organic and Ammonical nitrogen
- Determination of Nitrates
- Determination of Oil & Grease in wastewater
- Fluoride Determination
- Sulphate Determination
- Chloride Determination
- Determination of cations Ca+, Mg+, Na+ and Ni by Flame Photometer
- Heavy metals such as Cd, Cr, Pb etc. determination by Atomic Absorption Spectrophotometer
- Color Measurement and its removal using O3, Microscopy
- Bacteriological quality measurement: MPN, plate count
- Determination of NO_2 and SO_2 concentrations
- Visit to Water and Wastewater Effluent Treatment Plants and Report writing on field visit

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
- **CLO-2:** Statistically analyse and interpret laboratorial results.
- **CLO-3:** Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.
- **CLO-4:** Understand and use the water and wastewater sampling procedures and sample preservations.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER I
(Lab 2)

Course Code: EPCL2 **Course Name: Environmental Monitoring laboratory Lab**
Course Credit Hour: 2hr **Total Contact Hour:** 20hr

Course Objective:

- To introduce students to how the common environmental experiments relating to water and wastewater quality are performed.
- This course will help students know which tests are appropriate for given environmental problems, statistically interpret laboratorial results and write technical reports, and apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.

Course Description: MNP test and other model of septic and inhof tank need to perfom in lab.
Course Contents
LIST OF EXPERIMENTS

1. Study of instruments and equipment's.
2. Bacteriological culture Media-Liquid and Solid media.
3. Preparation, distribution and sterilization,
4. Isolation of microbes from Soil, Water and Air samples.
5. Culture of organisms and staining.
6. MPN Test for coli-forms in water.
7. MPN Test for coli-forms in sewage.
8. To study model of septic and Inhofe tanks.
9. To study model of sewer in urban area.
10. To study model of sewerage systems.
11. Analysis of waste disposals in urban areas.
12. Determination of B.O.D. and C.O.D. for the given sample.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
- **CLO-2:** Statistically analyse and interpret laboratorial results.
- **CLO-3:** Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.
- **CLO-4:** Understand and use the water and wastewater sampling procedures and sample preservations.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER I
(ELECTIVE I)

Course Code: EPE1E1
Course Name: AIR QUALITY MODELLING & MANAGEMENT ENGINEERING
Course Credit Hour: 3hr
Total Contact Hour: 30hr
Course Objective:

- To make the students aware of history of air pollution; definition of air pollution and various types of sources and classification of air pollutants.
- To make the student aware of techniques and instrumentation of ambient air monitoring, establishment of ambient air monitoring stations; stack monitoring and experimental analysis of air gaseous and particulate air pollutants; standards and limits.

Course Description: understand the meaning of air polltent and their causes and effects.

Course Contents:
Module –I: Air-pollution – Meteorological and topographical effects of air movement, Fuel and atmospheric pollutants, Sources of diffusion of SO_2, NOx, CO and Smoke, Particulates and heavy Metals in air.

Module –II: Sampling Techniques and analysis of different gases and solid particulates, Effect of air pollution on human health, control techniques, air quality criteria and case studies.

Module -III: Introduction to Air Quality Modelling- Model classification, criteria for model selection, Theory of Gaussian plume model and its application, Introduction to boundary layer, turbulence - physical modeling approach Basic diffusion equation.

Module –IV: Noise -Introduction to the assessment and measurement of sound, Environmental effects and assessment of noise.

Module –V: Noise Control- Basic principles of noise control by acoustical treatment, Industrial and construction noise, air craft and airport noise, highway and rail traffic noise, control of noise, Effective noise management.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:
CLO1: Grasp the fundamentals of air pollution and its associated environmental impacts.
CLO2: Earn to describe the key concepts of air quality management.
Text Books:

1. Air pollution by Rao, M. N. and Rao, H. V. N., Tata McGraw-Hill Publishing Co; Ltd, New Delhi, 1993.
2. Air Pollution Control Engineering by Nevers, N. D., McGraw-Hill International Ed., 1993.
3. Introduction to Environmental Engineering and Science by G. N. Pandey, and G.C. Carney, Master Gillbert M., Prentice Hall, New Delhi (2000)

Reference books:

1. Air Pollution: Its Origin and Control by Wark, K. and Warner, C.F., Harper and Row, New York, 1981.
2. Air Pollution Engineering Manual by Wayne T. D., John Wiley & Sons, 2000.
4. 3. Environmental Pollution Control Engineering by Rao, C. S., New Age Int. Pubs, 1991, Reprint, 2005.
5. Noise Pollution by Pandey V., Meerut Publishers, 1995.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER I
(ELECTIVE I)

Course Code: EPE12
Course Name: ENERGY AND ENVIRONMENT
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To learn about various energy sources available and their application
- Impart knowledge on conservation of energy

Course Description:Understanding the energy requirement of society and energy storage concept.

Course Contents:

Unit – I:Energy Requirement of Society: Energy requirement: past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Hydel power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies.

Unit II:Environmental Friendly Technologies: Sources, methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy.
Biomass option: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy, waste to energy

Unit -III:Energy Storage : Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems.
Unit -IV:Heat Energy Recovery : Heat Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective , principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Develop energy efficient process
- **CLO-2:** Focus on the conservation of energy while developing industrial processes

Text Books:

1. Energy and Environment by Richard Loulou, Jean-Philippe Waaub and Georges Zaccour, Springerlink
2. Energy and the Environment by Robert A. Ristinen and Jack P. Kraushaar, John Wiley& Sons Inc.

Reference Books:

1. Energy and environment by Bilash Kanti Bala, Nova Publishers
2. Ecologically Sound Integrated Regional Energy Planning by T. V. Ramachandra, Nova Science Publishers
3. Biomass, energy, and environment by N. H. Ravindranath, David Oakley Hall, Oxford University Press
4. Rural energy for sustainable development technology and environmental issues by Pradeep Chaturvedi, Indian Association for the Advancement of Science, Concept Publishing Company
5. Handbook of organic waste conversion by Bewik M.W.M.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER I
(ELECTIVE I)

Course Code: EPE13
Course Name: ENVIRONMENTAL TOXICOLOGY
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:
- Exposure of man and animal to potentially hazardous environmental factors of chemical, biological or physical nature.
- The effects caused by such exposure on health of man, animal and environment.

Course Description: to undersatnd the absorption of toxicant and distribution and storage.
Course Contents
Unit I: Introduction to Environmental toxicology, Environmental changes and diseases, Environmental legislation, Dose-Response Relationships

Unit II: Absorption of Toxicants, Distribution and Storage of Toxicants, Pathway analysis of intoxication, Biotransformation and Elimination of Toxicants, Target Organ Toxicity, Neurotoxic, nephrotoxic, hepatotoxic, Teratogenesis, Mutagenesis & Carcinogenesis, Toxic reactions with the molecules of life, Dioxin & Related Compounds

Unit III: Risk Assessment and Risk Management-I, Hazard estimation in exposure scenarios, Risk Assessment and Risk Management- II, The tools and troubles of risk assessment and management, Selenium Ecotoxicology, Arsenic in Drinking Water, Sources, pathways, receptors and controls.

Unit IV: Environmental Chemicals : Heavy metals, metalloids, nutrients, radionuclides Industrial chemicals, pesticides, petrochemicals, biotoxins

Unit V: Environmental Endocrine Disruption, Monitoring Chemicals in the Environment, Frontiers in Environmental Toxicology

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:
- **CLO-1**:Critically evaluate different advanced exposure assessment methods
- **CLO-2:** Design strategies for exposure assessment
- **CLO-3:** Analyze and interpret exposure measurements applying different modelling tools (stochastic and deterministic).

Text Books & Refrences:

1. Environmental Toxicology and Chemistry: Donald G. Crosby , Oxford University Press, USA (1998).
2. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998).
3. Principals of Environmental Toxicology: Ian C. Shaw and John Chadwick, Taylor and Francis, USA (1998).

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER I
(ELECTIVE II)

Course Code: EPE21
Course Name: SOIL AND GROUNDWATER CONTAMINATION
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To introduce the various types of improvement methods of engineering properties soils.
- To introduce the application of engineering methods to ground improvement projects.

Course Description:to undersatnd the physical properties of soil and water flow.

Course Contents

Unit-I: Physical Properties of Soil
Soil profiles, soil texture, soil classes, particle size distribution and analysis; soil as a multiphase system; Density and volume –mass –weight relations- particle density, void ratio, porosity, air filled porosity, bulk density, water content & volumetric water content.

Unit-II: Water Flow in Soil
Unsaturated zone: Introduction to unsaturated soil mechanics; infiltration process; water retention property; soil-water characteristic curve; flow of water through unsaturated soil; factors affecting unsaturated hydraulic conductivity; hydraulic diffusivity; mechanisms of soil-water interaction.
Saturated zone: Introduction; Darcy's law; limits of Darcy's law; Darcy's law & water flow through soil columns; storage coefficient; permeability & hydraulic conductivity; factors affecting permeability & hydraulic conductivity;
Underground formations; types of formation; homogeneity; heterogeneity; isotropy & anisotropy of soils; saturated flow in layered media.

Unit-III: Solute Transport
Physical processes & movement of solutes; Contaminant transport phenomenon- hydrodynamic & mechanical dispersion, molecular diffusion, advection, adsorption; dispersion coefficient; sorption reaction; Sources of pollution- point & non-point sources; conservative & non-conservative pollutants; soil-water-contaminant interaction; force of attraction & repulsion; contaminant transport & retention, transport of organic constituents in the unsaturated zone.

Unit-IV: Solute Transport Modeling
Introduction to advanced soil characterization techniques; governing equations for flow & pollutant transport in surface & subsurface soil; Ground water quality modelling.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Acquire the knowledge of laboratory and in situ tests for soil improvement projects
- **CLO-2:** Acquire the knowledge of surface compaction.
- **CLO-3:** Understand the concept of admixture stabilization
- **CLO-4:** Understand the concept of deep densification.

Text Books:

1. Martin, L.J. and McCucheon, S.C, Hydrodynamics of transport for water quality modeling, Lewis Publishers, Boca Raton, 1999.
2. Freeze, R.A. and Cherry. J.A. Groundwater, Prentice Hall, 1979.

Reference Books:

1. Mitchell, J. K and Soga, K Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
2. Fang, H-Y, Introduction to Environmental Geotechnology, CRC Press, 1997.
3. Daniel, D. E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993
4. Rowe, R. K., Quigley, R. M. and Booker, Clay Barrier Systems for Waste Disposal Facilities, J. R., E & FN Spon, 1995.
5. Rowe, R. K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER I
(ELECTIVE II)

Course Code: EPE22
Course Name: MODELLING AND SIMULATION
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To study different types of modelling in Environmental Systems with an aim to develop understand and apply Computational Fluid Dynamics in Environment and economical modelling.

Course Description: Models of heat transfer equipment sepration proceesses models of reactors.

Course Contents:

UNIT I:Introduction :Introduction to process modeling and simulation, tools of simulation, approaches of simulation, planning of calculation in a plant simulation.
Parameter Estimation:
Parameter estimation techniques in theoretical as well as numerical models.
UNIT II:Models: Models, need of models and their classification, models based on transport phenomena principles, alternate classification of models, population balance, stochastic, and empirical models, unit models.
UNIT III:Models of Heat Transfer Equipment:: Development of detailed mathematical models of evaporators, use of Newton-Raphson method for solving evaporator problems.
UNIT IV:Models of Separation Processes:
Separation of multicomponent mixtures by use of a single equilibrium stage, flash calculation under isothermal and adiabatic conditions.
Tridiagonal formulation of component-material balances and equilibrium relationships for distillation, absorption and extraction of multicomponent.
Thiele and Geddes method plus θ - method and Kb method, models of absorbers , strippers and extractors.
UNIT V:Models of Reactors: Classification of fixed bed reactor models, one dimensional and two-dimensional fixed bed reactor models, fluidized bed reactor models, bioreactor models.Numerical Methods:Classification of partial differential equations (PDE's), solution of PDEs by Finite difference techniques, method of weighted residuals.
Orthogonal collocation to solve PDEs with their application to chemical engineering systems models.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Recognise, discuss, apply, test and critically evaluate different model types.
- **CLO-2:**Recognise, discuss, apply, and test the applications of CFD in environmental modelling.

Books and References

1. Environmental Modelling: Finding Simplicity in Complexity by John Wainwright and Mark Mulligan, John Wiley & Sons, Ltd.
2. Building Environmental Models: A Primer on Simplifying Complexity by Mulligan, M. and Wainwright, J., John Wiley & Sons, Ltd, Chichester.
3.Earth-system science, in Blackwell Companion to Environmental Geography by Wainwright, J., 4. Blackwell, Oxford .

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3 (Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER I
(ELECTIVE II)

Course Code: EPE23
Course Name: MANAGEMENT IN WASTAGE
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To learn about the methods used for the treatment of wastewater biologically.
- To make the students understand modeling and design aspects of biological techniques available.

Course Description: to evavulate hrd and hrm and their method.
Course Contents:
Unit-I :WASTAGE sector in Indian Scenario, Concepts of Management, Administration and Organization, Key problems in WATSAN sector, Unaccounted for Water
Unit-II: Performance indicators in WATSAN Sector (subjective, objective), Institutional development, Institutional appraisal, capacity building, Techniques for Institutional development
Unit-III:PEST/STEP analysis, activity and responsibility matrix, objective performance indicators, Organization structure
Unit-IV: Techniques for Capital Budgeting (PBP, NPV, IRR), Financial management, Average incremental cost method, Tariff fixing, historical and financial ratings , CAFÉ principle, Public private Partnerships and related issues (PPP), need of P3, concession contract, Types of contracting services, Management, BOOT, BOT, contracts
Unit-V:HRD: need for HRD/HRM in WATSAN sector, Harvard/Warvick model, Change management, Services for urban poor in context with water supply, marketing in water supply systems Introduction to environmental economics, case studies in water and sanitation
Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Get the concept of a unit operation and a unit process.
- **CLO-2:** Acquire fundamental scientific processes underlying the design and operation of wastewater treatment plant.
- **CLO-3:** Manage the residuals from water and wastewater treatment.

Text Books &Refrences:

1. Dilip Kumar Majumdar, Irrigation Water Management (Principles & Practices), Prentice Hall of India (P), Ltd, 2004
2. Water Resources Systems, "Vedula & Mujumdar", McGrawHill, 2005.
3. Daniel P. Loucks, Water Resources systems Planning and Management (Studies and Reports in Hydrology) , 2006

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER II

Course Code: EPCT3 **Course Name: UNIT PROCESS**
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To apply knowledge of mathematics, physics, chemistry, and microbiology to solve and analyse engineering problems related to water and wastewater collection, transport, quality and treatment.
- To use the fundamental principles of mass balance, chemical kinetics and equilibrium to design water or wastewater reactors to achieve a desirable treatment goal.

Course Discription: Mass Transport Phenomenon, Fundamentals of Biological Treatment, Filtration and Disinfection, Filtration and Disinfection, Anaerobic Treatment Systems and sludge Handling need to study in brief .

Course Contents

Unit – I:Mass Transport Phenomenon: Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.

Wastewater Effluent standards -Water quality indices, Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers. Mixing, Clarification - Coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, Clariflocculation, Design of slow and rapid mixers

Unit II:Fundamentals of Biological Treatment: Objectives and fundamentals of biological treatment, Constituents of wastewaters - Sources – Significant parameter types of biological treatment processes, Fundamentals of Process Kinetics, Zero order, First order, Second order Reactions, Enzyme reactions – Bio reactors, Types-Classification – Design principles, Design of wastewater treatment systems-Primary, secondary and tertiary treatments, Evaluation of Bio-kinetic Parameters- Activated Sludge and its process - Modifications, Biological Nitrification and de-nitrification.

Aeration- Fundamentals of gas transfer- Attached Growth Biological Treatment Systems-Trickling Filters, Rotating Biological Contactors-Activated Bio filters Waste stabilization Ponds and Lagoons: Aerobic pond, facultative pond, anaerobic ponds- polishing ponds, aerated Lagoons

Unit III:Filtration and Disinfection: Filtration - theory of granular media filtration; Introduction to depth filtration, Classification of of filters; slow sand filter and rapid sand filter; filtration processes, mechanism of filtration; filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters. Modes of operation and operational problems; negative head and air binding; dual and multimedia filtration

Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose

Unit IV:Anaerobic Treatment Systems and sludge Handling: Anaerobic Processes-Process Fundamentals-Standard, high rate and hybrid reactors, Anaerobic filters-Expanded /fluidized bed reactors-Up flow anaerobic sludge blanket reactors, - Expanded granular bed reactors- Two stage/phase anaerobic reactors, Sludge Digestion, Sludge disposal

Unit V:Advance Water and Wastewater Treatment Systems: Ion Exchange-processes, ion exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener, Introduction and Application of Membrane Processes, Reverse osmosis, Ultra-filtration, Electro-dialysis, Adsorption: Adsorption processes, causes and types of adsorption, influencing factors adsorption equilibria- adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors,

Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Select or construct appropriate treatment schemes to remove certain pollutants present in water or wastewater.
- **CLO-2:** Design a water or wastewater treatment component.
- **CLO-3:**Balance chemical reactions and use balanced reactions to determine the distribution of species at equilibrium

Text Books:

1. Wastewater engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw-Hill, New Delhi, 2003.
2. Wastewater treatment plants: planning, design, and operation by S. R. Qasim, Technomic Pub. Co., 1999

Reference Books:

1. Environmental Engineering by Peavy, H.S., Rowe, D.R., Tchobanoglous, G., McGraw Hills, New York 1985.
2. Physicochemical processes for water quality control by Weber, W.J., John Wiley and sons, Newyork, 1983.
3. Biological Processes Design for wastewaters by Benefield, L.D. and Randall C.W., Prentice-Hall, Inc. Eaglewood Cliffs, 1982.
4. Biological wastewater treatment: Theory and Applications by Grady Jr. C.P.L and Lin H.C., Marcel Dekker, Inc New York, 1980.
5. Chemistry for Environmental Engineering and Science by C.N. Sawyer, P.L. MacCarty and G.F. Parkin,, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
6. Environmental chemistry – A global perspective by G.W. Vanloon and S.J. Duffy, Oxford University press, New York., 2000.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	- 40%

SEMESTER II

Course Code:EPCT4 **Course Name: REMOTE SENSING & GIS**
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- Provide comprehensive instruction in the underlying concepts and principles of geographic information system (GIS) technology and its application to the design and analysis of civil and environmental engineering systems.

Course Discription: Remote Sensing, Remote Sensing Platforms, Geometric & Radiometric corrections, Geographical Information System need to study in brief.

Course Contents:

Unit-I: Remote Sensing: Basic concepts, Multi-Concepts in Remote Sensing, Advantages of Remote Sensing data, Applications of Remote Sensing.

Unit--II: Remote Sensing Platforms & Sensors, Remote sensing data products, referencing scheme, Digital data Format and characteristics, High Resolution Images, Image Processing Software.

Unit--III: Geometric & Radiometric corrections, Visual Image Interpretation Methods, Digital Image Enhancement, Digital Image Classification Methods, Accuracy Assessment.

Unit-IV: Geographical Information System; basic concepts of GIS, Digital representation of geographic data, Digitization of features, Database creation, Raster and Vector based GIS data, Overlay analysis, Buffering, Query, Spatial analysis- 3-D Analysis, Introduction of GIS software, Applications of GIS, National Map policy, National Spatial Data Infrastructure in India.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Analyze the basic components of GIS.
- **CLO-2:** Classify the maps, coordinate systems and projections.
- **CLO-3:** Process spatial and attribute data and prepare thematic maps.

Text Books:

1. Remote Sensing & DIP: by Lillesand & Keifer, John Wiley & Sons, Inc.
2. Principles of Geographical Information Systems, by Burrough, P. A. / Burrough, P. A., Oxford University Press.

Reference Books:

1. Principles of Remote Sensing: by Curran, P. J.
2. Introduction of Digital Image Processing: by J. R. Jhonson, John Wiley & Sons, Inc.
3. Fundamentals of Geographical Information System, by DeMers, Michael N, John Wiley & Sons, Inc.
4. The GIS Book, 5th Edition, by Korte, George, Thomson Learning

Landscape Planning: Environmental Applications, March, W. M., Wiley Sons, New York

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER II
(Lab 1)

Course Code: EPCL3 **Course Name: REMOTE SENSING AND GIS LABORATORY**
Course Credit Hour: 2hr **Total Contact Hour:** 20hr

Course Objective:

- Provide comprehensive instruction in the underlying concepts and principles of geographic information system (GIS) technology and its application to the design and analysis of civil and environmental engineering systems.

Course Discription: all remote sesnsing and gis software work must be done in lab.
Course Contents
List of Experiments and Laboratory Exercises-

1. Demonstration of different type of remote sensing data products.
2. Collection of radiometric data from different surfaces using digital spectral radiometer or available data and preparation of spectral reflectance curve – Two exercises
3. Learning how to identify correct remote sensing data product and their referencing schemes
4. Visual interpretation of remote sensing imageries to extract different information.
5. Demonstration of scanning of TOI Toposheets and other maps on A0 size scanner.
6. Demonstration of Remote Sensing software (ERDAS Imagine).
7. Pre-processing of remote sensing data using ERDAS Imagine software.
8. Learning image enhancement and feature extraction techniques using digital image processing techniques.
9. Unsupervised classification of remote sensing images.
10. Supervised classification of remote sensing images using ERDAS Imagine.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Analyze the basic components of GIS.
- **CLO-2:** Classify the maps, coordinate systems and projections with help of parllar bar.
- **CLO-3:** Process spatial and attribute data and prepare thematic maps.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER II

(Lab 2)

Course Code: EPCL3 **Course Name: WATER QUALITY LAB**
Course Credit Hour: 2hr **Total Contact Hour:** 20hr

Course Objective:

- To introduce students to how the common environmental experiments relating to water and wastewater quality are performed.
- This course will help students know which tests are appropriate for given environmental problems, statistically interpret laboratorial results and write technical reports, and apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.

Course Description: All water parameters must be perfom in lab.

Course Contents

LIST OF EXPERIMENT

1. To determine the total solids, suspended solids and dissolved solids for a given sample of water.
2. To determine the alkalinity of a given sample of water.
3. To determine the total hardness and carbonate hardness for a given sample of water.
4. To determine the turbidity of a given sample of water
5. To find out the colour and odour of a given sample of water
6. To determine the percentage of Magnesium, Calcium, Iron, silica and Aluminum in a given sample of water
7. To determine the percentage of sulphates, chlorides, Iodide, Fluoride.
8. To determine the percentage of Sodium and Potassium in a given sample of water
9. To determine the concentration of dissolved oxygen in a given sample of water and find out the oxygen consumed.
10. To determine the percentage of Ammonia and Nitrogen present in a given sample of water

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
- **CLO-2:** Statistically analyse and interpret laboratorial results.
- **CLO-3:** Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions.
- **CLO-4:** Understand and use the water and wastewater sampling procedures and sample preservations.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER II
(ELECTIVE I)

Course Code:EPE3E
Course Name: ENVIRONMENTAL IMPACT ASSESSMENT
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- Appreciate the purpose and role of EIA in the decision-making process.
- Understand strengths & limitations of environmental management.
- Know procedures Understand screening & scoping processes Interpret options for evaluating environmental and social impacts.

Corse Discription: Evolution of EIA and EIS, Rapid and Comprehensive EIA, Assessment of impacts, Documentation of EIA need to study in brief.
Course Contents:
Unit-I: Evolution of EIA and EIS: Concepts, Methodologies, Screening, Scoping, Base line studies, Mitigation, Matrices, Check list

Unit-II: Rapid and Comprehensive EIA, Legislative and Environmental clearance procedures in India, Prediction tools for EIA

Unit-III: Assessment of impacts: Biological, Air, Water, Soil, and Noise, Socio cultural environment, Public participation, resettlement and rehabilitation

Unit-IV: Documentation of EIA: Environmental Management plan, Post project monitoring, Environmental Audit, Life cycle assessment, EMS, Case studies in EIA

Unit-V:Planning and Management of Environmental Impact Studies, Environmental cost benefit analysis, Decision methods for evaluation of alternatives, Sustainable development, Environmental policy in planned, mixed and market economies.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Understand the different steps within environmental impact assessment.
- **CLO-2:** the implications of current jurisdictional and institutional arrangements in relation to environmental impact assessment
- **CLO-3:**Understand how to liaise with and the importance of stakeholders in the EIA process.

Text Books & Reference:

1. Larry W Canter, Environmental Impact Assessment, 2nd Ed, McGraw-Hill, 1997.
2. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw-Hill International Edition, 1985.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER II

(ELECTIVE I)

Course Code: EPE31
Course Name: Environmental Impact Assessment and Audit
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To learn about the importance of Environmental Impact Assessment.
- To understand the methods followed for the impact assessment.

Course Discription: Introduction to EIA, Environmental Impact Assessment planning, Environmental Audit, Environmental Audit need to study in brief.
Course Contents:

UNIT 1: Introduction to EIA & Audit, Environment & Industries, Input information, Plant operation, Environmental Management planning, Waste Streams impact on water bodies. 8

UNIT 2: Environmental Impact Assessment planning. Activities, Methodology for Environmental Impact Assessment, Role of Environmental Engineering firm, Role of Regulatory agencies & control boards, Role of the Public. 8

UNIT 3: Environmental Audit: Introduction , Environmental information Purpose & advantage of studies, General approach of environmental Auditing Environmental Audit , Audit programs in India, Auditing program in major polluting Industries , Reports of the Environmental audit studies . 8

UNIT 4: Pollution prevention and control laws & acts: Constitution of India & environment , Constitution protection to Environment laws , Administrative & legislative arrangement for Environmental production , Indian Standards , Pollution control acts in India , critical appraisal ,fiscal incentives for environmental protection . 8

UNIT 5 Guidelines of preparation of project report and its evaluation, methods of clearance from the concern authorities at various labels.
Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Make decision based on the environmental consequences of proposed actions.
- **CLO-2:** Promote environmentally sound and sustainable development by identifying appropriate measures.

Text & References:

1. "Environmental pollution & Control in Chemical process Industries by S.C. Bhatia " Khanna Publishers", Delhi
2. Environmental impact assessment by Canter.
3. Environmental Chemistry by Stanley E. Manahan, VIth Ed. Lewis Publishers, London
4. Dying Wisdom: Rise, Fall, and potential of India's Traditional rain water harvesting systems by Anil Agarwal & Sunita Narayan, CSE Publication. New Delhi.
5. Environmental Impact Assessment (Theory and Practice) by Peter Wathern, Routledge (Taylor and Frances Group), London and New York.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER II

(ELECTIVE I)

Course Code: EPE42 **Course Name: INDUSTRIAL WASTE WATER TREATMENT**
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- Present scenario of industrial waste management in India nationally, in Maharashtra and in other states.
- Industrial waste generation patterns, as well as management and disposal techniques.
- Central and state pollution control board guidelines on industrial waste management

Course Discription: Environmental Audit, Neutralization, Removal of suspended and Industrial Complexing for Zero Pollution attainment need to study in brief.

Course Contents:

Unit-I c, nature and characteristics, quantity and quality of industrial wastes and their impact on the environment, Problems of industrial wastewater in India, Industrial treatment Processes; Inventorization and treatment of Industrial waste

Unit-II Effluent Disposal, Waste volume reduction, Effects of Discharges of Industrial Waste on Receiving Bodies of water, land and Sewer; Environmental legislation and standards related to industrial waste, Waste strength reduction

Unit-III: Neutralization, Removal of suspended and colloidal solids, Removal of inorganic and organic dissolved solids

Unit-IV: Sludge Thickner, Sludge Stabilization, Sludge conditioning and dewatering, Disposal of sludge solids, Waste treatment methodologies for specific industries

Unit-V: Industrial Complexing for Zero Pollution attainment, Wastewater generated from Textile (cotton and Synthetic) Tannery, Pulp and Paper, Dairy, metal Plating (Chromium and Cyanide problem), Slaughter House, Distillery, dying and Printing, fertilizer, Copper & cement Industry;Potentials for Wastewater Recycle and Reuse in industries; Concept of Common effluent treatment plants.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Schemes, incentives, policies on industrial waste management
- **CLO-2:** Overview of product design for waste minimization.
- **CLO-3:** Cost benefit analysis of different waste management techniques

Text Books:

1. Wastewater engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw-Hill, New Delhi, 2003.
2. Industrial waste treatment Handbook by Frank Woodard, Butterworth Heinemann, New Delhi, 2001.

Reference Books:

1. Environmental Engineering by Peavy, H.S., Rowe, D.R., Tchobanoglous, G., McGraw Hills, New York 1985.
2. Physicochemical processes for water quality control by Weber, W.J., John Wiley and sons, Newyork, 1983.
3. Biological Processes Design for wastewaters by Benefield, L.D. and Randall C.W., Prentice-Hall, Inc. Eaglewood Cliffs, 1982.

Biological wastewater treatment: Theory and Applications by Grady Jr. C.P.L and Lin H.C., Marcel Dekker, Inc New York, 1980.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER III

Course Code: EPE42
Course Name: Fundamentals of Sustainable Development
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- Provide an interdisciplinary training to equip students for understanding of the environmental and climate change dimensions of development trends and interventions.

Course Discription: Principles of Sustainable Development, Indians Judiciary System & Sustainable Development,Socio-economic, Agenda for Future Global Sustainable Development: Sustainable Development Systems need to study in brief.

Course Contents:

UNIT I: Principles of Sustainable Development: History and emergence of the concept of Sustainable Development – Definitions – Environmental issues and crisis – Resource degradation – green house gases – desertification – social insecurity – Industrialization – Globalization and Environment.

UNIT II: Indians Judiciary System & Sustainable Development: Judicial System in India – Induction of sustainability concepts through legal systems – concepts – principles – doctrines – case laws. Sustainable Development and International Contribution: Components of sustainability – Complexity of growth and equity – International Summits – Conventions – Agreements – Transboundary issues – Action plan for implementing sustainable development – Moral obligations and Operational guidelines.

UNIT III : Socio-economic Sustainable Development Systems: Socio-economic policies for sustainable development – Strategies for implementing ecodevelopment programmes – Sustainable development through trade – Economic growth – Carrying Capacity – Public participation.

UNIT IV : Agenda for Future Global Sustainable Development: Role of developed countries in the sustainable development of developing countries – Demographic dynamics and sustainability – Integrated approach for resource protection and management. Recent trends in Sustainable technological development.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:: Gathering of data, assessing and reporting of Environmental Impacts.
- **CLO-2:** Understand the meaning of sustainable development and its implementation in Finance, Trade, Technology, Science and Education and Population.

Text Books

1. Kirkby, J., O' Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London,1996.
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

References

3. Kirkby, J., O' Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London,1996.
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
5. Bowers, J., Sustainability and Environmental Economics – an alternative text, Longman, London, 1997.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER III

Course Code: EPE43 **Course Name: Integrated Watershed Management**
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

- Student can desgin watershed with help of basic degin parameters.
- To understand the water harvesting process and to build it for socity work and saving the water.

Course Discription: INTRODUCTION, WATER HARVESTING, PRINCIPLES OF EROSION and LAND MANAGEMENT need to study in brief.

Course Contents:

Unit-1:INTRODUCTION: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multidisciplinary approach for watershed management.

Unit-2:WATER HARVESTING: CHARACTERISTICS OF WATERSHED: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socioeconomic characteristics, basic data on watersheds, Rainwater Harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks,

Unit-3:PRINCIPLES OF EROSION: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation, MEASURES TO CONTROL EROSION: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.

Unit-4 :LAND MANAGEMENT: Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils. 8 Unit-5 Planning of watershed management activities, peoples participation, preparation of action plan, administrative requirements.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:Design strategies for watershed for natural water saving.
- **CLO-2:** Analyze and interpret exposure measurements applying different types of method to implement the mesthod of harvesting in land managemnet.

Text books:

1. Watershed Management by JVS Murthy, - New Age International Publishers.
2. Water Resource Engineering by R.Awurbs and WP James, - Prentice Hall Publishers.

Reference:

1. Land and Water Management by VVN Murthy, - Kalyani Publications.
2. Irrigation and Water Management by D.K.Majumdar, Printice Hall of India

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER III

(ELECTIVE V)

Course Code: EPE51
Course Name: Solid and Hazardous Waste Management
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- Understanding of problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc.
- Knowledge of legal, institutional and financial aspects of management of solid wastes .
- Become aware of Environment and health impacts solid waste mismanagement.
- Understand engineering, financial and technical options for waste management

Course Discription: Solid Waste, Collection and Transportation of Solid Waste, Solid Waste Disposal, Hazardous Waste need to study in brief.
Course Contents
Unit-I: Solid Waste: Origin, Types, characteristics, Quantity and Analysis; Effects of Solid Wastes on environment, Solid waste transformation, Legislation in solid waste, Waste generation rates, Composition, Hazardous Characteristics, Toxicity characteristic leaching procedure (TCLP) tests, waste sampling, Source reduction of wastes, Recycling and reuse, Integrated solid waste management

Unit-II: Collection and Transportation of Solid Waste: Handling and segregation of wastes at source, storage and collection of municipal solid wastes, Analysis of Collection systems, Need for transfer and transport, Transfer stations,

Unit-III:Solid Waste Disposal: Disposal in landfills, site selection, design and operation of sanitary landfills, landfill remediation, Elements of integrated waste management

Unit-IV:Hazardous Waste: Definition, Sources and classification of hazardous wastes, labeling and handling of hazardous wastes, Risk and risk assessment, management and handling of hazardous wastes, and biomedical wastes

Unit-V:Waste to Energy: Waste processing, processing technologies, biological and chemical conversion technologies, Composting, thermal conversion technologies, energy recovery, incineration, solidification and stabilization of hazardous wastes,

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Do sampling and characterization of solid waste;
- **CLO-2:**analysis of hazardous waste constituents including QA/QC issues;
- ***CLO-3:***understand health and environmental issues related to solid waste management;

Text Books:

1. Tchoboglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993
2. Wentz, C. A., Hazardous Waste Management, 2nd Ed., McGraw Hill, 1995.
3. Bhide A.D and Sudarshan (1976) Solid waste management in developing countries.
4. Manual on Municipal Solid waste management, Central Public Health and
Environmental Engineering Organization, CPHEEO, Government of India, New Delhi, 2000.

Reference Books:

1. La Grega, M. D., Buckingham, P. L. and Evans, J. C., Hazardous Waste Management, 2nd Ed., McGraw Hill, 2001.
2. Bagchi, A., Design, Construction and Monitoring of Landfills, Wiley Interscience, 1994.
3. Haas, C. N. and Vamos, R. J., Hazardous and Industrial Waste Treatment, Prentice Hall, 1995.

Martin, E.J. and Johnson, J.H., Hazardous Waste Management Engineering, Van Nostrand, 1987.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%

Total Internal Assessment - 40%

SEMESTER III

(ELECTIVE V)

Course Code: EPE52 **Course Name: Environmental Geotechnology**
Course Credit Hour: 3hr **Total Contact Hour:** 30hr

Course Objective:

- To impart to the students, in-depth knowledge about the basic concepts and theories of foundation engineering;
- To enable the students to acquire proper knowledge about various methods of foundation analysis for different practical situations .

Course Discription: Introduction, Identification, Load environment factor design criteria, Ash Pond and Mine Tailing Impoundments need to study in brief.

Course Contents:

Unit 1: Introduction, Development of Environmental Geotechnology, Aims, Environmental Cycle and their interaction with geotechnology, Natural environment, cycles of nature, environmental geotechnical problems.

Unit 2: Identification and characteristics of contaminated soil, classification, Characteristics of dust, dust in environment, ion exchange reaction and ion exchange capacity, ion exchange reaction in contaminated soil water system, Site Investigation for detection of sub surface contamination

Unit 3: Load environment factor design criteria, soil structure vs structure soil interaction, load and environmental loads, bearing capacity based on load footing interaction, lateral earth pressure, pile foundations, environmental factors affecting pile capacity, under water foundation problems.

Unit 4: Ash Pond and Mine Tailing Impoundments, Geotechnical re use of waste materials and fills, Grouting and injection process, Grout used for controlling hazardous wastes, Sinkhole: interaction with environment, remedial action.

Unit 5 Sanitary landfills: Selection of waste disposal sites, Landfills for Municipal and Hazardous wastes, Design of liners: clay and synthetic clay liners, Bearing capacity of foundation on sanitary landfills.

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**:the basic concepts, theories and methods of analysis in foundation engineering;
- **CLO-2:**the field problems related to geotechnical engineering and to take appropriate engineering decisions.

Recommended Books:

1. Fang, H. Introduction to Environmental Geotechnology.
2. Sharma, H. D. and Sangeeta, P.L. waste containment systems, waste stabilization and landfills: design and evaluation.
3. Koerner, R. M. Designing with geosynthetics
4. Geoenvironmental Engineering by Haro D. Sharma, Krishna R. Reddy, Wiley House Publishers.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER III

(ELECTIVE V)

Course Code:EPE53 **Course Name:** Rural Water Supply And Sanitation
Course Credit Hour: 3hr Total Contact Hour: 30hr

Course Objective:

- To understand the concept of desinging the water system distribution in rural area.
- Improve the water quality and distributation and minimize the wastege of water in rural area.

Course Description: Concept of environment and scope of sanitation in rural areas, Water supply, Improved methods and compact systems of treatment of surface need to study in brief.

Course Content:

Unit-1 Concept of environment and scope of sanitation in rural areas. Magnitude of problems of rural water supply and sanitation. Population to be covered, difficulties. National policy.

Unit-2 Water supply: Design population and demand loads. Various approaches of planning of water supply schemes in rural areas. Development of proffered sources of water springs. Wells, infiltration wells, radial wells and infiltration galleries, collection of raw water from surface source. Specific practices and problems encountered in rural water supply.

Unit-3 Improved methods and compact systems of treatment of surface and ground waters for rural water supply. Brief Details of multi-bottom settlers (MBS), diatomaceous earth filter, cloth filter, slow sand filter, chlorine diffusion cartridges. Pumps, pipe materials, appurtenances and improved devices for use in rural water supply. Planning of distribution system in rural areas.

Unit-4 Community and sanitary latrines. Various methods of collection and disposal of night soil. Planning of waste water collection system in rural areas. Treatment and Disposal of waste water. Compact and simple waste water treatment units and systems in rural areas such as stabilization ponds, septic tanks, Imhoff tank, soak pit etc. Disposal of waste water soakage pits and trenches.

Unit-5 Disposal of Solid Wastes. Composting, land filling, incineration, Biogas plants, Rural health. Other specific issues and problems encountered in rural sanitation.

Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO-1**:Understand the meaning of Disposal of soild wastes and try to manage their wastage.
- **CLO-2:** Community and sanitary latrines must be provided and guided their improtance for hygen in rural area.

Text books & Refrence:

1. 'Water Treatment and Sanitation – Simple Method for Rural Area' by Mann H.T. and Williamson D.
2. 'Water Supply for Rural Areas & Small Communities' by Wanger E.G. and Lanoix J.N., WHO
3. 'Water Supply and Sewerage', by E.W.Steel & T.J.Mcghee, McGraw Hill.
4. Manual on Water Supply and Treatment', CPHEEO, Mini. Of Urban Development, Govt. of India.
5. Manual on Sewerage and Sewage Treatment', CPHEEO, Mini. Of Urban Development, Govt. of India
6. 'Environmental Engineering' by D. Srinivasan, PHI Learning Pvt. Ltd. 2009

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER III

(OPEN ELECTIVE)

Course Code: M0M03 **Course Name: OPERATION RESEARCH**
Course Credit Hour: 4hr **Total Contact Hour:** 30hr

Course Objective:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

Course Discription: LinearProgramming,Introduction, Simplex method definition,The Transportation Model Solution Methods: need to study in brief.
Course Contents:
Unit-1: LinearProgramming (LP), LP and allocationof resources, LPP definition, Formulation of LPP, Maximization and Minimization problems. Graphical solution of LPP
Unit-2: Introduction, Simplex method definition, formulating the Simplex model. Linear Programming–Simplex Method for Maximizing, Simplex maximizing example for similar limitations,Example containing mixed constraints (Big-M Method),
Unit-3: The Transportation Model Solution Methods: Feasible Solution: The Northwest Method, The Lowest Cost Method; Optimal Solution: The Stepping Stone Method, Modified Distribution(MODI)Method. The Assignment Model
Unit-4: Project Management: Rules for drawing the network diagram, Application of CPM and PERT techniques, Replacement Problem: Replacement of assets that deteriorate with time, replacement of assets which fail suddenly.
Course Learning Outcomes (CLOs):
On completion of the course students will be able to:

- **CLO**:Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems.

Text Books & References:
1) Vohra- Quantitative Techniques in Management (Tata McGraw-Hill, 2nd edition), 2003.
2) Peter C Bell- Management Science/ Operations Research (Vikas)
3) Kothari- Quantitative Techniques (Vikas), 1996, 3rded.
4) Akhilesh K B and Balasubramanyam S- Quantitative Techniques (Vikas)
5) TahaHamdy- Operations Research- An Introduction (Prentice-Hall, 7th edition), 1996, 5th ed.
6) J K Sharma- Operations Research (Pearson)

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40**

SEMESTER III

Course Code: MTC03 **Course Name: Dissertation Phase 1**
Course Credit Hour: 16hr
Dissertation interim evaluation, Seminar on Dissertation and Comprehensive Viva Voce-III

It will be taken up by the student at the end of the second semester and the duration would be six months. This is aimed at training the students to analyse independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill. The evaluation of dissertation will be based on continuous internal assessment comprising two seminars, one internal Viva-voce and an external Viva-voce examination.

SEMESTER -IV

Course Code: MTC04 **Course Name: Dissertation Phase 2**
Course Credit Hour: 16hr

Dissertation interim evaluation, Seminar on Dissertation and Comprehensive Viva Voce-III

It will be taken up by the student at the end of the third semester and the duration would be six months. This is aimed at training the students to analyse independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill. The evaluation of dissertation will be based on continuous internal assessment comprising three seminars, one internal Viva-voce and followed by open defense.

The term work under this, submitted by the student shall include –

1. Work diary maintained by the student and counter signed by his guide.
2. The contents of work diary shall reflect the efforts taken by candidate for

(a) Searching the suitable project work
(b) Visits to different factories or organizations
(c) Brief report of journals and various papers referred
(d) Brief report of web sites seen for project work
(e) The brief of feasibility studies carried to come to final conclusion
(f) Rough sketches
(g) Design calculation etc. etc. carried by the student.

The student has to make a presentation in front of panel of experts in addition to guide as
The dissertation submitted by the student on topic already approved by university authorities on the basis of initial synopsis submitted by the candidate shall be according to following guidelines –

Format of dissertation report –

The dissertation work report shall be typed with double space on A4 bond paper. The total number of pages shall not be more than 150 and not less than 60. Figures, graphs, annexures etc. be added as per requirement. The report should be written in the following format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures / photographs / graphs / tables
5. Abbreviations
6. Abstract / final synopsis
7. Contents
8. Text with usual scheme of chapters
9. Discussion of the results and conclusion
10. Bibliography (The source of illustrative matter be acknowledged clearly at appropriate place)

decided by department head.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Industry and Production Engineering

M.Tech (Industrial-Production)

Mechanical engineering is one of the oldest and broadest fields of engineering. Mechanical engineering deals with the design, construction, and use of machines with maintenance of mechanical systems to help the society building.. It is more helpful when it is taught at Post Graduate level. Master of Technology in Industrial- Production Engineering is helpful to students who are interested in building their carriers in manufacturing sector and to conduct independent research in R&D labs in industries and higher educational institutes. It is branch of engineering that involves mechanical power of machines to develop the economical product and built the customer base and market to distribute and sale the product.

Program Educational Objectives (PEOs)

PEO-1: To demonstrate a high level of competency and problem-solving aptitude to find innovative solutions to theoretical and practical problems
PEO-2: To provide the knowledge for design and analysis of systems based on the laws of industrial and production engineering
PEO-3: To improve the skills in communication, decision making and foster the neck of developing technological innovation to compete globally
PEO-4: To impart students to develop sustainability with regards to work, and develop the values which are ethically, economically and socially viable**.**

Program Specific Outcomes (PSOs)

PSO-1: Students will be able apply the knowledge of production and design aspects of engineering
PSO-2: Students will be able to develop the to develop the problems solving skills by imbibing different simulation and mathematical tools.
PSO-3 : Students will be able to Conduct independent research in the field of production Engineering by using different software tools in the area of manufacturing.
PSO-4 : Students will be able to Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility

Program Learning Outcomes (PLOs)

PLO-1 : Ability to apply advanced knowledge for design, evaluation and analysis of manufacturing and industrial systems
PLO-2: Capability to apply modern tools for product conceptualization, design and development
PLO-3: Ability to judiciously employ state-of-the art research techniques
PLO-4: Ability to investigate and design complex problems through experimentation
PLO-5: Capability to develop independent thinking in assessing and evaluating technical solutions

Credit System-Credit requirement for award of M.Tech:

- Every semester shall offer a minimum of **16 credits** and a maximum of 18 **credits**.
- Credits for the Dissertation project vary from 10 to16 credits.
- The total number of credits for the M. tech Degree Course is 68 credits
- All courses of study put together would engage the students for a **minimum of 24 periods of** or hours of study a week and a **maximum of 26 periods** or hours a week.

Under the choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Program Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
   (i) Program Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
   (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate‘s proficiency or skill
c) Mandatory course :Research Methodology and IPR course is more profound of all course as it teaches different techniques of research and understanding to conduct independent research.Apart from this an indepth knowledge of Patent and copyright laws are also part of this curriculum.
d) Audit course: Which enables the exposure towards building blocks of society. The cultural, social values and understanding of India's growth and reform policy to nuture candidate understanding and enhancing skill to bring gap between industry and curriculum .

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits
1	Program core	12
2	Program Elective	15
3	Open Elective	3
4	Audit course	0
5	Seminar, Dissertation Phase- I and II and Labs	36
6	Mandatory Courses	2
		68

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 2 Hours Practical (Lab)/week 1 credit
- 1 Hr. Dissertation Phase -I and II (P) per week 0.5 credit
- 2 hr Seminar /week 1 credit
-

Credit distribution in each semester (68 credits to 4 semesters)

Semester	**Credits**		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16
Total	32	36	68

Semester-1

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
IPCT1	Advance Welding Technology	3	0	0	40	60	100	3
IPCT2	Machine Tool Design	3	0	0	40	60	100	3
IPE1x	Program Elective-1 (1) Design Of Production System (2) Optimizations Technique (3) Design of Welded Joints	3	0	0	40	60	100	3
IPE2x	Program Elective-2 (1) Production Technology (2) Robotics and Automation (3) Operation Planning and Control	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
IPCL1	Welding Lab	0	0	4	40	60	100	2
IPCL2	CAD Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
IPCT3	Advanced Metal Forming	3	0	0	40	60	100	3
IPCT4	Computer Integrated Manufacturing	3	0	0	40	60	100	3
IPE3x	Program Elective-3 (1) Statistics of Decision Making (2) Additive Manufacturing (3) Advance Machining Process	3	0	0	40	60	100	3
IPE4x	Program Elective-4 (1) Advanced Material Processing Technique (2) Finite Element Method (3) Mechatronics	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
IPCL3	Metal Forming Lab	0	0	4	40	60	100	2
IPCL4	Computer Integrated Manufacturing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
IPE5X	Program Elective-5 (1) Design and Analysis of Experiment (2) Supply Chain Management (3) Surface engineering	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective
MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

SEMESTER-I

DETAILED CURRICULUM CONTENTS

Paper Code: IPCT1 **Course Name** : Advanced Welding Technology

Course Credit : 3 **Total Contact hrs :** 40 hrs

Course Objective:

- To identify the tools and techniques associated with welding-related fabrication and quality control.
- To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications.
- To develop the knowledge on the design of welded joints and the quality control of weldments.

Course Description:

This course provides students with opportunities to effectively perform cutting and welding applications of increasing complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the welding technology course while learning additional techniques not covered in previous courses. Specifically, students will be proficient in fundamental safety practices in welding, gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), shielded metal arc welding (SMAW), and quality control methods.Upon completion of this course proficient students will be prepared to complete the American Welding Society (AWS) Entry Welder qualification and certification.

Course content:

UNIT-1 Welding Metallurgy: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lammellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

UNIT-2 Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.

UNIT-3 Modern Trends in Welding: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

UNIT-4 Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanisation of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

UNIT-5 Robotics in Welding: Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.

Course Learning outcome (CLOs):

At the end of course student will be able to

- Understand the basics of welding technology
- Formulate and implement the weld joint design procedure and problems
- Learn and gained elementary knowledge regarding weld design

Text Books:

- Advanced Welding Processes Nikodaco & Shansky MIR Publications
- Welding Technology and Design VM Radhakrishnan New Age International

Reference Books:

- Source Book of Innovative welding Processes M.M. Schwariz Americal Society of Metals (Ohio)
- Advanced Welding Systems, Vol. I, II, III J. Cornu Jaico Publishers
- Manufacturing Technology (Foundry, Forming and Welding) P.N. Rao Tata McGraw Hill

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107090/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : IPCT2

Course Name : Machine Tool Design

Course Credit Hour: 3 hr

Total Contact Hour : 40hr

Course Objective :

- The student can identify different areas of Machine Tool Design.
- Can find the applications of all the areas in day to day life.

Course Description :

This course emphasizes on the fundamental of Tool design. This course has been developed with orientation towards research related activities and recognizing the knowledge as property. It will create consciousness for Machine tool design and its constituents. The course demonstrates the Tool design techniques, the tool designs needed according to research problem.

Course Contents :

UNIT-1.

Introduction-Calculation Data (Forces, Velocities and Power Requirements during metal cutting: Turning: Cutting force, Cutting Speed and Feed Rate. Drilling: Cutting forces, Cutting Speed and Feed Rate. Milling: Chip Section, Cutting force, Milling with Cutter Heads. Grinding: Grinding Forces, Cutting Speed, Feed Rate, and Depth Setting. Planning, Shaping and Broaching.

UNIT-2.

General Requirements of the Machine Tool: Accuracy of Shape, Dimensional accuracy and surface finish of the components produced. High Productivity. High Technical and Economic Efficiency.

UNIT-3.

Design Principles: Stiffness and Rigidity of the Separate Constructional Elements and their Combined behavior Under Load, Static Rigidity, Dynamic Rigidity, Natural frequencies, Damping, Mode of Vibration. Standardization of Spindle Speeds and Feed Rates: Layout of Speed Change Gears. Saw Diagrams for Arithmetic Progression, Geometric Progression, Harmonic Progression and Logarithmic Progression of spindle speeds for Mechanical Stepped Drives for Machine Tools. Establishment of Gear Ratios, Layout of the Intermediate Reduction Gears,

UNIT-4

Calculation of Transmission Ratios, Pulley Diameter, Gear Wheel Diameters and Number of Teeth. Ray Diagram. Speed Diagram. Electrical, Mechanical and Hydraulic Drives for the Operational Movements: Electric Drive and Control Equipment. Mechanical and Hydraulic Drives. Drives for Producing Rotational Movements, Stepped Drives, Step less Drives. Drives for Producing Rectilinear Movements. Backlash Eliminator in the Feed Drive Nut.

UNIT-5

Automatic Control: Principles and Constructional Elements. Automatic Driving of the Cutting Movements, Feed Movements, and Return Movements. Automatic control of movements for Starting, Stopping and Reversing. Automatic Clamping and Unclamping the work piece. Automatic Selection of Required Speeds, Automatic Setting of Tools. Automatic Measurement of Machined Shape and Surfaces. Transport of Components from One Machine to the Next. Applications (Examples of Automatic Machines). Design of Constructional Elements: Machine Tool Structures, Structural Elements Design for Centre Lathe, Drilling Machine, Knee Type Milling Machine, Planning Machine, Boring Machine, and Grinding Machines. Design of Slide Ways: Design of Slide ways for Tables, Saddles and Cross-slides. Antifriction Bearings for slide ways. Hydrostatically Lubricated Slide ways.

Course Learning Outcomes(CLOs) :

- Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal/oblique cutting.
- Identify basic of machine tools design about precision and operation on various tools.
- Design under factor of stiffness , load, vibration , harmonic motion of the machine tools to produce a component.
- Select a machining operation like rotational, transverse movements used for designing corresponding machine tool for a specific application in real time.
- Select a measuring instrument to inspect the dimensional and geometric features of a given component.

Text books :

- Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger
- Machine Tool Design by N. K. Mehta. McGraw Hill Publishing

Reference books :

- Machine Tool Design by Acherkan, Mir publishing
- Machine Tool Design by S.K, Basu, Oxford and IBH Publishing
- Machine tool design by Sen and Bhattacharya, CBS Publication

Online links for study & reference materials :
https://www.youtube.com/watch?v=hRexymJSf
U&list=PLOiT2XTdTTBeHMfMrUlfDZRyDoK4Hw2vW

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE11

Course Name: Design of Production System

Course Credit: 3

Total Contact Hour: 40 hr

Course Objective:

- To impart state-of-the-art knowledge of principles and techniques for the efficient design and analysis of mechanical systems and structural components.
- To impart training in research methodology and current industrial practices with enhanced emphasis on theoretical, experimental and computational skill development.
- To inculcate out-of-box thinking, effective communication skills and sensitivity to ethical issues.

Course Description:

The course is designed to build on a customer-cantered perspective, understanding and skills to meet future industrial situation. By working in an industrial project the students will be trained to identify and analyse problems based on given conditions in an actual industrial context. In the production system design process, the objective is to design the best possible. production system starting from the existing preconditions and the resources and options. available

Course Content:

UNIT 1:

Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT 2:

Properties of Engineering Materials,
Selection of Materials – I, Selection of Materials – II, Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II.

UNIT-3

Selection of Manufacturing Processes,
Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co selection of Materials and Processes, Case-Studies – III

UNIT -4

Design for Assembly,Review of Assembly Processes, Design for Welding – I, Design for Welding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies - IV

UNIT-5

Design for Reliability,

Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization,

Course Learning Outcomes (CLOs):

- Understand the product development cycle
- Know the manufacturing issues that must be considered in the mechanical engineering design process
- Know the principles of assembly to minimize the assembly time
- Know the effect of manufacturing process and assembly operations on the cost of product (not included by others)
- Be familiar with tools and methods to facilitate development of manufactural mechanical designs

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 00.

Reference books:

- S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
- G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
- J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE12 **Course Name:** Optimization Technique
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To learn the theory of optimization method and algorithms developed for solving various types of optimization probem.
- To develop research interest in applying optimization technique in problems of engineering and technology.
- To analyze real life system with limited constraint.

Course Description:

The objective of this course is to provide the students with knowledge on the application of various optimization techniques which can help making decisions for practical problems in industries. Modeling concepts and applications of linear, integer, nonlinear, and dynamic programming as well as network models are addressed. Metaheuristic techniques are also discussed to obtain good solutions for large scale practical problems in a reasonable computational time. Optimization model and its applications are demonstrated for solving problems in Industry 4 era.

Course Contents:

Unit-I

Optimization Methods : One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods-quadratic & cubic interpolation methods. Direct search method – Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. Variable metric method.

Unit-II

Dynamic Programming: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

Unit-III

Sensitivity Analysis: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation: Introduction – Types – Steps – application – inventory – queuing – thermal system..

Unit-IV

Cutting Plane Method: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

Unit-V

Probability : Basic concepts of probability theory, random variables –distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of optimization techniques
- Formulate and implement the optimization procedure and problems
- Learn and gained elementary knowledge regarding soft computing techniques

Text books:

- S.S Rao; Optimization Theory & Applications, New Age International 2016.
- M.C Joshi, K.M Moudgalya; Optimization Techniques Theory and Practice , Narosa Publications..

Reference books:

- H.A. Taha; Operation Research/ /TMH
- P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008
- R.L Rardin Optimization in operations research.
- Benugundu & Chandraputla ;Optimization Techniques, Person Asia
- Kasan & Kumar; Introductory to operation research, Springar

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Online links for study & reference materials:

http:// //nptel.ac.in/courses/111/105/111105039/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE13 **Course Name :** Design of welded joints
Course Credit : 3 **Total Contact Hour :** 40 hr

Course Objective:

- To evaluate the static stresses in loaded welded structures
- To evaluate the developed dynamic stresses in the welding structures
- To Understand heat flow through welding joints
- To understand the destructive and non-destructive tests of the weldments

Course description:
Welding is one of the most common fabrication techniques. This course is aimed at familiarizing the students with the fundamentals weld joint design, metallurgical aspects in welding of steel, aluminium, and assessing the quality and suitability of weld joints. Topics related with weldability of metals shall also be covered to equip the students technological input for handling problems in weld joint design of selected metals and alloys.

Course content:

UNIT1
Heat flow in welding, Heat input, Effect of welding parameter on heat distribution; calculation of peak temperatures; thermal cycles; cooling rate and solidification;
UNIT-2
Residual stresses and their distribution in welds; influence of residual stresses in static and dynamic loading, distortion
UNIT-3
Design of weld joints Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading.
UNIT-4
Weld Calculations in lap, butt and fillet welds; design for fatigue loading, Introduction to Fatigue; nature of the fatigue process; fatigue strength.
UNIT-5
Factors affecting fatigue life; improvement methods for fatigue strength;reliability analysis and safety factors applied to fatigue design

Course Learning outcome (CLOs):
At the end of course student will be able to:

1. Understand the basics of welding technology
2. Formulate and implement the weld joint design procedure and problems
3. Learn and gained elementary knowledge regarding weld design

Text Books:

- The Metallurgy of Welding, 6th Edition , Lancaster, William Andrew Publishing, NY.
- Principles of Welding (Processes,Physics, Chemistry and Metallurgy), Robert and Messler, Wiley Interscience Publishers.

Reference Books:

- Welding Hand Book Vol. 5; 7th edition,AWS, 1984.
- Welding METALLURGY,S Kou, John Wiley, USA, 2003

Online links for study and reference materials:

https://nptel.ac.in/content/storage2/courses/112105125/pdf/mod10les4.pdf

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE II

Course Code: IPE21 **Course Name**: Production Technology

Course Credit: 3 **Total Contact Hour**: 40 hr

Course Objective:

To analyse and determine material fabrication processes.

- To use laboratory instrument doing routine metrological measurements>
- To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
- To recognize engine machine tool requirements and be selective in the choice of tools.
- To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
- To identify with numerical control machining and computer programming.
- To determine costs and establish basic programs in machine shop economics.

Course Description:

This course is a study of the modern techniques of design, production, and operations including material and process selection. The correct application of these concepts to engineering drawings is emphasized. The importance of concurrent engineering and computer-integrated manufacturing in design is examined.

Course Content:

UNIT 1:

Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT 2:

Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM

UNIT-3

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT -4

Processing of ceramics : Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application , finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT-5

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining

Course Learning Outcomes (CLOs):

- At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials.

Text books:

- Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
- Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.

Reference books:

- Advanced Machining Processes, V.K.Jain, Allied Publications.
- Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.
- Foundation of MEMS/ Chang Liu/Pearson, 2012.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE II

Course Code: IPE22 **Course Name**: Robotics And Automation

Course Credit: 3 **Total Contact Hour**: 20 hr

Course outcome:
At the end of course student will be able to:

1. Understand the basics of robotics and automation technology
2. Formulate and implement the automatic control procedure and problems
3. Learn and gained elementary knowledge regarding automation

Syllabus content:
UNIT-1 Introduction to Automation: Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation.

UNIT-2 High Volume Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines.

UNIT-3 Programmable Manufacturing Automation: CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations. Flexible Manufacturing Automation: Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system.

UNIT-4 Assembly Automation: Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems. Robotics: Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic.

UNIT-5 Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission methodRotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.

UNIT-6 Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.

References:

1. Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Automation in Production Engineering Oates and Georgy Newness -
4. Stochastic Models of Manufacturing Systems Buzacott & shanty Kumar Prentice Hall India
5. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
6. Robotics J.J. Craig Addison-Wesely
7. Robot Engineering: An Integrated Approach R.D. Klafter, t.a. Chmielewski and M. Negin Prentice

ELECTIVE II

Course Code: IPE23 **Course Name**: Operation Planning and Control

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- To acquire a comprehensive understanding of the principles and functions of OPC practised in manufacturing industry.
- To recognise the sequencing, balancing and scheduling problems in any operation system.
- To solve problems at operation level by using the appropriate production techniques

Course Description:

Effective Operation planning and control now stands at the core of every successful organizations as manufacturers strive to increase productivity without incurring unnecessary costs. As the need to deal effectively with the problems of production scheduling becomes more critical, staff needs to have a comprehensive understanding of the principles and functions of operation planning and control. Only then can these problems be solved through the appropriate production techniques.

Course Content:

<u>UNIT 1:</u>

Operations Planning Concepts: Introduction, Operations Functions in Organizations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing
systems, Definition of Operations management, Factors affecting productivity, International dimensions of productivity, The environment of operations.

<u>UNIT 2:</u>

Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology, Decision Tree Problems, Economic models- Break-even analysis in operations, P/V ratio. System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.

<u>UNIT-3</u>

Forecasting Demand: Forecasting objectives and uses, Forecasting variables, Opinion and

Judgmental methods, Delphi technique, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing,

UNIT -4

Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, BIAS, and Tracking Signal.

UNIT-5

Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate plan, Three Pure Strategies of Aggregate planning, aggregate planning methods, Master scheduling objectives, Master scheduling methods.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:

1. Understand the basics of operation planning and control
2. Formulate and implement the operations and control procedure and problems
3. Learn and gained elementary knowledge regarding operations concepts

Text books:

- Samson Eilon, "Elements of production planning and control", Universal BookCorpn.1984.
- Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / OperationsManagement", 8th Ed. John Wiley and Sons, 2000.

Reference books:

- Kanishka Bedi, " Production and Operations management", Oxford university press,2nd Edition 2007.
- Melynk, Denzler, " Operations management –A value driven approach" Irwin Mcgrawhill.
- Norman Gaither, G. Frazier, " operations management" Thomson learning 9th edition

Online links for study and reference materials:

https://www.udemy.com/course/manufacturing-operations-planning-management-and-control/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MTC01 **Course Name**: Research Methodology and IPR

Course Credit: 2 **Total Contact Hour**: 20 hr

Course Objective:

- Identify an appropriate research problem in their interesting domain
- To explain various research designs and their characteristics
- To explain the art of interpretation, art of writing research reports and presentation skills
- To explain various forms of intellectual property, its relevance and business impact in the changing global business environment

Course Description:

This course emphasizes on the fundamental of research. This course has been developed with orientation towards research related activities and recognizing the knowledge as property. It will create consciousness for intellectual property rights and its constituents. The course demonstrates the research formulation techniques, the research designs needed according to research problem. It also introduces aspect of effective literature review and the sources of information to be taken to conduct literature review. In concurrence with this, students will become familiar with the analysis part before the interpretation and decision on conclusion obtained. Finally concepts related to patents, trademark and copyright are also the part of this course which are of prime importance and needs to be understood.

Course Content:

UNIT 1:

Meaning of research problem, sources of research problem, characteristics of good research problem, errors in selecting a research problem, scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation. Necessary instrumentation

UNIT 2:

Effective literature studies approaches, analysis, plagiarism and research ethics

UNIT-3

Effective technical writing, how to write report, paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT -4

Nature of Intellectual property; patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development, International Scenario; International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-5

Patent Rights; Scope of Patents Rights, Licensing and transfer of technology; Patent information and databases, geographical Indications.

UNIT-6

New development in IPR, Administration of patent system, New developments in IPR, IPR of Biological system, Computer software etc. Traditional knowledge case studies, IPR and IITs.

Course Learning Outcomes (CLOs):

- Understand the characteristics, objects of good research problem.
- Understand concepts of data collection, analysis
- Understand significance, effective technical writing and report
- Understand the patent rights and transfer of technology

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- Wayne Goddard and Stuart Melville, '' Research Methodology: An Introduction''

Reference books:

- Ranjit Kumar, 2nd Edition,''Research Methodology: A step by step Guide for beginners''
- Halbert, '' Resisting Intellectual Property'', Taylor and Francis Ltd, 2007
- Mayali,'' Industrial Design'', McGraw Hill, 1992.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Audit course-I

Course Structure

Course Code: MAC04 **Course Name:** Value Education
Course Credit Hour: 4hr **Total Contact Hour:** 60hr

Course Objective:

1. To make students understand the relevance of individual values in everyday lives
2. To help students imbibe different individual values in their personality
3. To help students develop good moral values and positive character
4. To help students learn the significance of self management and self-control

Course Description:

The course is an appropriate combination of theoretical and industry specific contents on values and works ethics aimed at developing students into professionals. The course enables students learn concepts related to values and description of different types of values like individual values, social values, organizational values, etc. The course emphasizes on significance of cultivation of individual values that are essential in a personality and lists out various individual values to be imbibed in a student preparing for professional world. The course also describes various practical aspects of value education like managing good health, self-control, science of reincarnation, religious tolerance and role of women, which are pre-requisites for good moral character and competence.

Course Contents: The course is divided into 4 broad units namely:

1. **Unit-1: Values and Self-development**, Social Values and Individual attitudes, work ethics and Indian vision of humanism, moral and non-moral valuation, standards and principles, value judgments
2. **Unit-2: Importance of cultivation of values**, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanlinesss, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline
3. **Unit-3: Personality and Behaviour Development,** soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, freedom from anger, dignity of labour, universal brotherhood, religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature
4. **Unit-4: Character and Competence,** holy book vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind your self, self-control, honesty, studying effectively

Course Learning Outcomes (CLOs):

CLO-1: The students will be able to relate to concepts related to value education in their everyday lives.

CLO-2: The students will be able to demonstrate individual values cultivated in their respective workplaces or professional world.

CLO-3: The students will be able to differentiate between the different types of values and imbibe them as part of their self-development.

CLO-4: The students will be able to learn and practice techniques of managing good health, self-control, gender sensitivity and religious tolerance.

Text books:

1. Indrani Majhi, Ganesh Das, VALUE EDUCATION, 1, 2017, Laxmi Publications Pvt Ltd, ISBN: 9789352741120, 9352741129
2. Sharma Sandeep, Encyclopedia of Indian Ethos and Values in Management, Anmol Publications Pvt Ltd, ISBN: 9788126139187, 9788126139187

Reference books:

1. UN-HABITAT, Human Values And Ethics In Workplace: Improving Leadership And Performance In The Water Education, Water Supply And Sanitation Sector, 2006, United Nations Human Settlements Programme (UN-HABITAT)
2. Ganesh A. Gayatri, Values Attitude and Practices, Publisher: Discovery Publishing Pvt. Ltd, ISBN: 9789350561287, 9789350561287
3. Atkinson Camille E., Women, Ethics and the Workplace, ABC-CLIO, ISBN: 9780275960919, 9780275960919
4. Green Connie Ragen, Rethinking the Work Ethic, Hunter's Moon Publishing, ISBN: 9781937988333, 9781937988333

Online links for study & reference materials:

1. https://www.researchgate.net/publication/228079327
2. https://www.researchgate.net/publication/49586890
3. https://www.researchgate.net/publication/258040203
4. https://www.enterpreneur.com/amphtml/310254
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705678

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-term exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course code: IPCL1 **Course Name:** Welding Lab

Course Credit: 4 **Total contact hours : 40 hrs**

Course Objective:

- To learn the practical application of fabrication of weld joint
- To understand weld procedure specification

LIST OF EXPERIMENTS

1. Arc striking practice.
2. Bead-on-plate welding
3. Effect of welding parameters on weld bead by
-GTA welding
-GMA welding
-Submerged arc welding
4. Microstructural observation of weldments
-Carbon steel
-Stainless steel
-Aluminium alloy
-Titanium alloy
-Dissimilar joints
5. Practice for preparation of welding procedure specification.
6. Practice for preparation of procedure qualification record

Course Learning outcome (CLOs):

At the end of this course students will be able to:

1. Understand the basics of welding technology
2. Formulate and implement the weld joint design procedure and problems
3. Hands on experience in fabrication of weld joint design

Online links for study and reference materials:

http://mmcoep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Course Code: IPCL2 **Course Name**: CAD Lab

Course Credit: 2 **Total Contact Hour**: 20 hr

Course Objective:

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

Course Description:

This is an introductory course in freehand sketching and computer-aided drafting/ design. Students will be taught basic CAD commands, tools, multi-view drawing and dimensioning techniques.

Course Content:

1. 3D GEOMETRIC MODELLING Introduction of 3D Modelling software

2. Creation of 3D assembly model of following machine elements using 3D Modelling software

    - Flange Coupling
    - Plummer Block
    - Screw Jack
    - Lathe Tailstock
    - Universal Joint
    - Machine Vice
    - Stuffing box
    - Crosshead
    - Safety Valves
    - Non-return valves
    - Connecting rod
    - Piston
    - Crankshaft

3. Manual Part Programming
    - Part Programming - CNC Machining Centre
      a) Linear Cutting.
      b) Circular cutting.
      c) Cutter Radius Compensati
      d) Canned Cycle Operations.
    - Part Programming - CNC Turning Centre
      a) Straight, Taper and Radius Turning.

b) Thread Cutting.
c) Rough and Finish Turning Cycle
d) Drilling and Tapping Cycle.

4. Computer Aided Part Programming
    - CL Data and Post process generation using CAM package
    - Application of CAPP in Machining and Turning Centre.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:
1. Understand the basics of 3D modelling
2. Formulate and implement the softwares of design 2D and 3D modelling
3. Hands on experience regards design and fabrication of manufacturing components

Text books:

Reference books:

Online links for study and reference materials:

https://www.udemy.com/course/autocad-2018-course/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

SEMESTER-II

DETAILED CURRICULUM CONTENTS

Course Code: IPCT3 **Course Name:** ADVANCED METAL FORMING

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To make them learn the fundamentals of manufacturing technology.
- To impart the basic knowledge of advanced metal forming processes.
- To understand the design and analysis of complex mechanism of metal forming processes.
- To implement the above knowledge in solving the practical engineering problems in various production units.

Course Description:
This course is an advancement and elaboration of the metal forming processes used in the production technology. This course describes about various advanced metal forming processes which includes the materials metallurgical behavior and the mechanics used behind these processes. Concepts used in the manufacturing technology will be applied in this course as a pre requisite. The course addresses the difference between the conventional and un-conventional approaches in metal forming processes. This course will help students to understand the design and analysis of upcoming future production technology.

Course Contents:

UNIT-1
Advanced metal forming processes: Tube and sheet hydroforming, Theoretical analysis (theory of plasticity), Stress-strain relationship, Strain hardening, Material incompressibility, Work of plastic deformation, Work hardening, Yield criteria, Flow rule, Yield criterion and flow rule for Anisotropic material, Initiation and extent of plastic flow- Problems.

UNIT-2
High energy rate forming processes: EMF, EHF and explosive forming. Design of dies for forging,extrusion and wire drawing, Overview of various metal forming operations: Conventional Vs High velocity forming methods – Material behavior – Mechanics of Various Plastic Flow Problems Forging; Workability of testing techniques, Tribology in metal forming and other phenomena.

UNIT-3
Die design: Die design for sheet metal forming processes such as single and multi-stage deep drawing, bending and stretch forming.

UNIT-4
Mechanics and Materials in Metal forming processes: Materials used for making forming tools, Lubrication mechanisms, Metal forming equipment, Formability testing of sheet metals,

Sheet forming: Mechanics – Flow Rules – Anisotropy - Formability of sheet, Formability tests, Forming limit diagrams, Case studies.

UNIT-5

Forming Limit Diagrams: Determination of Forming Limit Diagrams and their applications, Warm forming, Micro forming. Pressing and Sintering: Workability Studies – Densification - Problems & Case Studies

Course Learning Outcomes (CLOs) :

At the end of course students will be able to:

1. Solve for strain rates, temperatures and metallurgical states in forming problems using constitutive relations
2. Develop process maps for metal forming processes using plasticity principles.
3. Estimate formability limits for sheets and bulk metals.
4. Evaluate optimum process parameters for pressing and sintering

Text/ Reference books:

1. Surender Kumar, Technology of Metal Forming Processes, Prentice - Hall, Inc., 2008.
2. Henry S. Valberg, Applied Metal Forming - Including FEM Analysis, Cambridge University Press, 2010.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107250/ /

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: IPCT4 **Course name** : Computer Integrated Manufacturing

Course credit : 3 **Total contact hours** : 40 hrs

Course Objective:

- Students will be introduced to CAD/CAM/CAE concepts
- Specify appropriate manufacturing processes for the fabrication of mechanical components
- Students will learn about importance of data generation and management in CIMS.

Course description:

This course demonstrates the concepts of CIM. It describes the ways of controlling business operation by means of CIM. Through this course the students will understand the concepts of CAPP (computer-aided process planning), SQC(statistical quality control), optimization of MRP (Manufacturing Resource Planning) and JIT(Just in Time). Group technology and artificial intelligence are also useful part of CIM system.

Course content:

Unit-1 Introduction to CNC Machine Tools: Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept.

Unit-2 CNC Programming: Co-ordinate System, Fundamentals of APT programming, Manual part programming-structure of part programme, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines-IDEAS, Unigraphics, Pro Engineer, CATIA, ESPIRIT, MasterCAM etc., and use of standard controllers-FANUC, Heidenhain and Sinumeric control system.

Unit-3 Tooling for CNC Machines: Cutting tool materials, Carbide inserts classification; Qualified, semiqualified and preset tooling, Cooling fed tooling system, Quick change tooling system, Tooling system for machining centre and turning center, tool holders, Tool assemblies, Tool magazines, ATC mechanisms, Tool management.

Unit-4 Robotics and Material Handling Systems: Introduction to robotic technology, and applications, Robot anatomy,material handling function, Types of material handling equipment, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Work-in-process storage, Interfacing handling and storage with manufacturing.

Unit-5 Group Technology and Flexible Manufacturing System: group Technology-part families, Parts classification and coding, Production flow analysis, Machine Cell Design, Benefits of

Group Technology, Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.

Unit-6 Computer Integrated Manufacturing: Introduction, Evaluation of CIM, CIM hardware and software, Requirements of computer to be used in CIM system, Database requirements, Concurrent engineering Principles, design and development environment, advance modeling techniques.

Course Learning outcome (CLOs) :

At the end of this course students will be able to:

1. Understand the basics of Computer integrated manufacturing
2. Formulate and implement the CNC and NC programming tool
3. Learn and gained elementary knowledge regarding material handling system

Text Books:

- Computer Numerical Control Machines P. Radahkrishnan New Central Book Agency
- CNC Machines M.S. Sehrawat and J.S. Narang Dhanpat Rai and Co.

Reference Books:

- CNC Programming Handbook Smid Peter Industrial Press Inc.
- Automation, Production systems and Computer M.P. Groover Prentice Hall of India IntegratedManufacturing

Online links for study and reference materials:

https://nptel.ac.in/courses/112/104/112104289/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE III

Course Code: IPE31 **Course Name**: Statistics of Decision Making

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- To develop the students ability to deal with numerical and quantitative issues in business
- To enable the use of statistical, graphical and algebraic techniques wherever relevant.
- To have a proper understanding of Statistical applications in Economics and Management.

Course Description:

All of us in our day-to-day life use numbers in our calculations. Organizations today are inundated with numerical data and information. In business, it is essential for managers to carry out data analysis and be able to interpret their results for effective decision-making. For this, they need to prepare quantitative arguments to justify their decisions. The Statistical Methods for Decision Making (SMDM) course teaches you how to use statistics to help take a real-world problem and apply various techniques to make effective business decisions.

Course Content:

UNIT 1:

Data, graphs, determinism vs. stochasticity, populations vs. samples, experimental
design, sampling, inference, bivariate data; scatterplots, least squares regression and correlation

UNIT 2:

Data reduction, descriptive statistics, "normal" distribution randomness, probability concepts, random variables (r.v.'s), distribution moments (mean, variance, etc.); discrete models
continuous probability models

UNIT-3

Sampling distributions, counts and proportions, point and interval estimation: confidence, significance, statistical tests Introduction to hypothesis testing; power and inference, inference for single and two populations

UNIT -4

Hypothesis testing and inference for two populations, and for population variance Good-of-fit tests, contingency analysis, and general categorical data analysis

UNIT-5

Introduction to Analysis of variance (ANOVA), two-factor analysis; Linear regression, correlation analysis, causation, and data transformations Statistical inference for regression parameter estimates.

Course Learning Outcomes (CLOs):

At the end of course students will be able to:

- Students can perform statistical analyses, including one-way ANOVA, two-way ANOVA, simple and multiple regression, time-series analysis, chi-square tests, and nonparametric methods.
- Students can identify the limitations of statistical analyses and when they should or should not be used.
- Student can utilize statistical software to carry out appropriate statistical analyses.
- D. Students can effectively communicate the results of statistical analyses in both oral and written orm through the use of both technical and nontechnical language.

Text books:

- Business Statistics, a Decision-Making Approach, 6th ed., David Groebner, P. Shannon, P. Fry, K. Smith, Prentice Hall, NJ, 2005, ISBN: 0130477850
- Statistics for Business and Economics, by Anderson, Sweeney, Williams, Camm,and Cochran

Reference books:

- Schaum's Series for problem practice.
- Mathematical Statistics by Ray, Sharma and Choudhary

Online links for study and reference materials:

https://www.greatlearning.in/academy/learn-for-free/courses/statistical-methods-for-decision-making/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE III

ADDITIVE MANUFACTURING

Teaching Scheme **Paper Code: IPE32**
Lectures: 3hrs/week

Course outcome:

At the end of this course students will be able to:

1. Understand the basics of additive manufacturing
2. Formulate and implement the rapid prototype procedure and problems
3. Learn and gained elementary knowledge regarding 3D modelling

Syllabus contents:

UNIT-1 Introduction: Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.

UNIT-2 RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seikis' solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc..

UNIT-3 Power based rapid prototyping systems, selective Laser sintering, Soligen Diren's shell production casting (DSPC), Fraunhofer's multiphase jet solidification (MJS) and MIT's 3D printing (3DP) etc.

UNIT-4RP Database: Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.

UNIT-5 RP Applications: Development of dies for moulding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues, etc., RP materials and their biological acceptability.

References:

1. Rapid Prototyping Of Digital Systems: A Tutorial Approach Hamblen James O Kluwer Aca
2. Rapid Prototyping: Principles And Applications Kai Chua Chee World Scie
3. Rapid System Prototyping With Fpgas: Accelerating The Design Process R C Cofer Newnes
4. Rapid Prototyping of Digital Systems James O Hamblen Springer

ELECTIVE III

Course Code: IPE33 **Course Name**: Advance Machining Process

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- The objective of the course is to provide the students the knowledge of modern manufacturing processes such as Ultrasonic machining, Abrasive machining processes, Electrochemical machining, Electro discharge machining & their modifications into hybrid processes.
- Also, to introduce them to advanced topics such as Laser beam welding/machining, Electron beam welding/machining & state of art in various research areas.

Course Description:

Today's stringent design requirements and difficult-to-machine materials such as tough super alloys, ceramics, and composites, have made traditional machining processes costly and obsolete. As a result, manufacturers and machine design engineers are turning to advance machining processes. These machining processes utilizes electrical, chemical and optimal sources of energy to machine the given job. Going through this subject students will get insight of various advanced machining processes and there system components, process variables and industrial applications. This is a perfect course for anyone designing, researching or converting to a more advance machining process.

Course Content:

UNIT 1:

Introduction to advanced machining processes and their classification Ultrasonic machining and its modelling and analysis.

UNIT 2:

Abrasive jet machining (AJM) Water jet cutting (WJC) and Abrasive water jet machining (AWJM) Magnetic abrasive finishing (MAF) and its modelling Abrasive flow finishing (AFF) and its modelling Magnetorheological finishing (MRF) Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

UNIT-3

Electric discharge machining (EDM):Principle, applications, process parameters, and modelling. Electric Discharge Grinding (EDG),Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM).

UNIT -4

Laser beam machining (LBM) Plasma arc machining (PAM) Electron Beam Machining (EBM) Electro chemical machining (ECM):Principle, applications, and process parameters and modelling

UNIT-5

Electrochemical Grinding (ECG),Electrostream Drilling (ESD),Shaped Tube Electrolytic Machining (STEM) Chemical machining (ChM)

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:

- Understand the basics of advance machining technology
- Formulate and implement the machining procedure and problems
- Learn and gained elementary knowledge regarding basic machining

Text /Reference books:

- V.K. Jain,Advanced Machining Processes,Allied Publishers, 2009.
- Gary F.Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987.
- J.A. McGeough,Advanced Methods of Machining, Springer, 1988.
- Hassan El-Hofy,Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005.
- V.K. Jain, Introduction to Micromachining,Alpha Science International Limited, 2010

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107078/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code: IPE41 **Course Name:** Advanced Material Processing Technique
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To understand the manufacturing processes including stir casting, tape castingprocess and high energy rate forming.
- To identify suitable hybrid welding process for welding a given material.
- To learn the working principle of Electron beam, laser beam and laser hybrid welding processes and suggest their applications.
- To analyze real life system with limited constraint.

Course Description:

This course is focused on physical understanding of materials processing, and the scaling laws that govern process speed, volume, and material quality. In particular, this course will cover the transport of heat and matter as these topics apply to materials processing.

Course Contents:

Unit-I

Overview: Outline of advanced materials processing techniques: Non-Conventional Materials Removal Processes; Finishing Processes; Forming; Advanced Surface Engineering Processes; Joining Technologies.. **Advances in Non-Conventional Machining Processes**: A brief review of non-conventional machining processes, Analysis of mechanical, thermal and Electrochemical type non-traditional machining processes. Tool design for selected non-traditional machining processes

Unit-II

Modelling and Simulation of selected processes: A comparative study of various processes. Advanced Fine Finishing Process: Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modelling of finishing mechanism; Parametric analysis; Applications

Unit-III

Fabrication of Micro-Devices Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication Laser Materials Processing Fundamentals of industrial lasers. Laser materials interaction theories. Laser processing for various industries such as metals, non-metals, photovoltaic, biomedical applications

Unit-IV

Advances in Metal Forming: Conventional processes-High Energy Rate Forming techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming , flow forming - Principles and process parametersAdvantages -Limitations and Applications. Overview of powder metal forming technique- Advantages-applications-Powder perform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters.

Unit-V

Micro-Machining : Introduction to micromachining technologies, Microelectro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro turning, micro-drilling and micro-milling, micro grinding, hybrid micromachining method, on-line measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of advanced material processing technique
- Formulate and implement the selected modeling and simulation procedure and problems
- Learn and gained elementary knowledge regarding non-conventional machining processes
- Apply advanced casting methods including V-process, lost foam process and Magnetic molding process for ceramics and composite material.

Text books:

- Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P Groover Wiley
- Manufacturing Engineering and Technology, 4/e, Serope Kalpakjian, Steven R Schmid, Pearson Education..

Reference books:

- Manufacturing Processes for Engineering Materials, 5/e, Serope Kalpakjian Pearson Education
- Modeling of Metal Forming and Machining Processes by Finite Element and Soft Computing Methods, P M Dixit
- Modern Machining Processes, Pandey, P.C., and Shan, H.S. Tata McGraw-Hill Education
- Micromachining of Engineering Materials J.A. McGeough. CRC Press
- Advance Method of Machining McGeough, J.A Springer.

Online links for study & reference materials:

http:// //nptel.ac.in/courses/ 113/105/113105081/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code :IPE42 **Course Name : FINITE ELEMENT METHOD**

Course Credit Hour : 3hr **Total Contact Hour :** 40hr

Course Objective :

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.

Course Description :

We used textbook and auxiliary handout reading assignments along with written homework assignments using both textbook problems and additional handout problems; classroom discussions including homework solutions and exam problem solutions. Computer assistanace using ANSYS that demonstrate its use for modeling/method/technique purposes, computer assignments using ANSYS augmented with hand/spreadsheet calculations to demonstrate its use for practical engineering design problems, using the computer to perform parameter studies to attain a better understanding of sources of error in FE models.

Course Contents :

Unit-1

Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches.

Unit-2

Shape functions,Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.

Unit-3

Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bendingproblems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems.

Unit-4

Idealisation of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics.

Unit-5

Numerical techniques, 3D problems, FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.

Course Learning Outcomes(CLOs) :

At the end of course students will be able to:

- Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer.
- Formulate and solve problems in one dimensional structures including trusses, beams and frames.
- Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems.
- Implement and solve the finite element formulations using MATLAB.

Text books :

- The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
- An Introduction to Finite Element Method J. N. Reddy McGraw Hill
- Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
- Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill

Reference books :

- Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
- Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
- Finite Element and Approximation O.C. Zenkiewicy & Morgan

Online links for study & reference materials :

https://nptel.ac.in/courses/112/106/112106135/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code: IPE43 **Course Name:** MECHATRONICS

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To make them learn the fundamentals of Mechanical and Electronics.
- To learn about the various data conversion devices, mechanical systems and control systems.
- To make the students enable to implement the mathematical approach in the design and analysis of mechatronic devices.
- To implement the above knowledge in solving the practical engineering problems.

Course Description:

This course is an intermixing of introduction of mechanical engineering and electronics engineering systems and the concepts used in these engineering branches. The course describes the introduction of mechatronics along with the detail about various mechanical and data conversion devices. The course addresses about the control systems, various mathematical functions and the modeling of these functions in real practical application of various mechatronic systems.

Course Contents:

UNIT-1

Introduction to Mechatronics: Definition, Mechatronics in manufacturing, products and design. Comparison between Traditional and Mechatronics approach. Electronics: Review of fundamentals of electronics, logic gates and their operations.

UNIT-2

Data conversion devices: Sensors, microsensors, transducers, electrical contacts, actuators, and switches, contactless input devices, signal processing devices; relays, output devices. Drives: Stepper motors, servo drives.

UNIT-3

Mechanical Systems: Ball screws, linear motion bearings, transfer systems. Hydraulics: Hydraulic elements, actuators and various other elements. Design of hydraulic circuits.

UNIT-4

Control Systems: Open loop and closed loop control, block diagrams, transfer functions, Laplace transforms; Mathematical model of physical system; PI and PID controllers, 8085 microprocessor, PLC controller and Ladder diagrams, hydrualic and pneumatic controllers.

UNIT-5

Time domain analysis: Transient response of first and second order systems; Introduction to nonlinear control; State space analysis, optimal and adaptive control; Intorduction to discrete-time systems and Z-transform. Design and fabrication of mechatronics systems.

Course Learning Outcomes(CLOs)

At the end of this course the students will be able to:

1. Understand the basics of mechatronics
2. Formulate and implement the electrical and mechanical components design procedure and problems
3. Learn and gained elementary knowledge regarding electronics design

Text books:

1. Mechatronics , HMT Ltd., TMH.
2. Mechatronics by W.Bolton Addison Wesley.

Reference books:

1.AutomaticControl Engineering by F.H.Raven, 5th ed., McGrawHill International.
2. Modern Control Engineering by K.Ogata, 3rd ed., Prentice Hall.
3. Automatic Control Systems by B.C.Kuo, 6th ed., Prentice Hall.
4. Machine design for mobile and industrial applications by G.W.Kurtz, J.K.Schueller, P.W.Claar, SAE.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107298/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: IPCL3 **Course Name:** Metal Forming Lab
Course Credit: 2 **Total Contact Hour:** 40hr

Course Objective:

- To learn practical process of metal forming.

List of Experiments

1. To study and observe through demonstration the metal forming process (Rolling process)
2. To study and analyze the process of open die forging
3. Estimation of power and cutting forces required in turning process
4. To analyze tool life at different machining variables
5. To study the non-conventional machining with demonstration of Electro Discharge Machining (EDM)
6. To study and analyze the process of metal extrusion process
7. To analyze the process of Closed die Forging
8. To study and observe various stages of casting through demonstration of Sand Casting Process.
9. To study and observe the welding process through demonstration and practice. (Spot welding)
10. To study and observe the welding process through demonstration and practice. (Electric Arc Welding)
11. To study and demonstration on CNC machining and understanding CNC Coding.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of metal forming
- Formulate and implement the metal forming design procedure and problems
- Hand on experience regarding rolling and wire drawing

Reference materials: https://nptel.ac.in/courses/112/107/112107250/ /

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Course Code: IPCL4 **Course Name**: Computer Integrated Manufacturing Lab

Course Credit: 2 credits **Total Contact Hour**: 40 hr

Course Objective:

To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's and to impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

- Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
- Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
- Nonlinear analysis (Exercise must include plastic deformation of simple objects or crash analysis simple structures.
- 3 Axis CNC code generations for CNC machining.
- CNC Machining of complex features like machining of hemispherical cavity, tapered hole, hole of parabolic shape etc.

LIST OF EQUIPMENTS REQUIRED:

1. Computers 18
2. CAD Workstation
3. FEA Software
4. CAM Software for
3 axis machining or more
5. CNC Production type lathe or Milling Machine

Course Learning Outcomes (CLOs):

After successful completion of Computer Integrated Manufacturing lab, the student will be able to CO

- Impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's. CO
- To impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements. CO
- Identify the main elements in computer integrated manufacturing systems; Apply knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes. CO
- Apply the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion; CO
- Process product models with CAM tools and CNC machines

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Teaching Scheme **Paper Code: IPCL4**

Practical: 4hrs/week

Course outcome:

At the end of this course students will be able to:

1. Understand the basics of computer integrated manufacturing
2. Formulate and implement the 3D modelling design and problems
3. Hand on experience regarding CAD software

LIST OF EXPERIMENTS

1. 3D Modeling using CAD software.

2. CNC programming on turning.

3. CNC programming on milling.

4. Simulation of CNC programming on CAM Software

5. Study and demonstration on Robots.

6. Basic Robot Programming and Simulation.

7. Study of computer controlled business functions.

8. Study of interfacing requirements in CIMS.

9. Generation of any surface using any CAD software.

10. Design/ Thermal Analysis by CAD Software

SEMESTER-III

DETAILED CURRICULUM CONTENTS

ELECTIVE V

Course Code: IPE51 **Course Name:** Design and Analysis of Experiments
Course credit : 3 **Total contact hours:** 40 hrs

Course Objectives:
- To learn the fundamental of experimental designs
- To understand analysis tools and techniques, interpretation and application.

Course description:
This the describes the ways to explore innovative strategies for constructing and executing experiments including factorial and fractional factorial designs that can be applied across the physical, chemical, biological, medical, social, psychological, economic, engineering and industrial sciences. This course will develop the ability to conduct cost-effective, efficient experiments and analyze the data that they yield in order to derive maximum value for your organization.

Course content:

UNIT-1
Introduction to DOE Overview and Basic Principles Simple Designs and Analysis of Variance Block Designs, Latin Squares and Related Designs

UNIT-2
Introduction to factorial Designs Full Factorial Designs 2-level Full Factorial and Fractional Factorial Designs , Blocking and confounding in the 2K factorial design

UNIT-3
Response surface methods and designs ANOVA, model checking, sample size, regression approach, central composite design

UNIT-4
Designs with Random Factors Nested Designs and Split-plot Designs , Fitting regression models

UNIT-5
Introduction to MINITAB , DESIGN EXPERT softwares

Course Learning outcome (CLOs):
At the end of course, student will be able to:
1.Learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions.
2. Both design and statistical analysis issues are discussed. Students will be expected to utilize standard statistical software packages for computational purposes.

References Books:
Design and Analysis of Experiments, 8th edition, Douglas C. Montgomery

Online links for study and reference materials:

https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-mg01/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE V

SUPPLY CHAIN MANAGEMENT

Teaching scheme **Paper code: IPE52**
Lectures:3hrs/week

Course outcome:
At the end of this course the students will be able to:

1. Understand the basics of supply chain management
2. Formulate and implement the forecasting design procedure and problems
3. Learn and gained elementary knowledge regarding transportation decisions

Syllabus content:

UNIT-1
Introduction to supply chain management: Supply chain basics, decision phases in supply chain, supply chain flows, supply chain efficiency and responsiveness, supply chain integration,process view of a supply chain, uncertainties in supply chain, key issues in supply chainmanagement, drivers of supply chain performance. Supply chain coordination, bullwhip effect,developing relationships in the supply chain, resolving conflicts in supply chain relationships,role of information technology in supply chain
UNIT-2
Demand forecasting in supply chain: Role of forecasting in supply chain, components of a forecast, forecasting methods, estimating level, trend and seasonal factors, Holt's model,
Winter's model, measures of forecast error. Role of aggregate planning in supply chain: Aggregate planning strategies, managing supply and demand in supply chain.
UNIT-3
Supply chain inventory: Role of cycle inventory in supply chain, economies of scale, lot sizing for a single product, lot sizing for multiple products, quantity discounts, trade promotions, price discrimination. Role of safety stock in supply chain, determining appropriate level of safety inventory, inventory replenishment policies, measures of product availability.
Sourcing decisions in supply chain: Supplier selection and contracts, design collaboration, making sourcing decisions in practice.
UNIT-4
Transportation decisions: Role of transportation in supply chain, factors affecting transportation decisions. Routing and scheduling in transportation.
UNIT-5
Logistics: Definition, logistics and SCM, international considerations, inbound logistics, internal logistics and outbound logistics. Reverse logistics, green supply chain.

References:
1. Sunil Chopra and Peter Meindl, "Supply chain management - strategy planning and operation", PHI
2. Handfield R. B., Nichols Jr. E. L., "Introduction to supply chain management", Pearson Education

3. Raghuram R. and Rangaraj N., “Logistics and supply chain management”, Macmillan, 2001
4. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., “Designing & managing the supply chain: concepts, strategies & case studies.” 2nd Edition, Tata McGraw-Hill, 2003
5. Agarwal D. K., “A text book of logistics and supply chain management”, Macmillan, 2003
6. Srinivasan, G., “Quantitative models in operations and supply chain management”, PHI

ELECTIVE V

Course Code: IPE53 **Course Name:** Surface Engineering

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Learn the principles and methodology of Industrial Surface Engineering
- Learn the rules of product-design and of the relevant surface engineering.
- Learn the rules of product-design and of the relevant surface engineering tehniques.

Course Description:

Thermal Spray is means of depositing a superior coating material having desired properties over a relatively in -expensive base material (substrate).The applied coating improves the life of treated components without affecting its mechanical properties. All thermal spray processes have three steps in common; feed coating material (in form of wire, powder and rod), heat that material to semi-molten stage, and transfer the material by force of gas or compressed air to the part being coated. The objective of this course is to introduce thermal spray technology for protecting surfaces for industrial applications such as gas turbines, IC engines (automobiles), boilers and several other engineering components. An interactive session based on real life case studies will illustrate the potential of thermal spray coatings. The course will help improvise the understanding of participants on thermal spray processes.

Course Contents:

Unit-I

Introduction to surface engineering: Importance and scope of surface engineering, conventional surface engineering practices like pickling, grinding, buffing etc.

Unit-II

Surface Engineering of Materials: surface engineering by material addition like electroplating, surface modification of ferrous and non-ferrous materials like nitriding, cyaniding, aluminizing etc.

Unit-III

Advanced Surface Engineering: practices like laser assisted surface modification, electron beam assisted modification, spraying techniques like flame and plasma spraying, high velocity oxy-fuel, cold spray techniques.

Unit-IV

Surface Modification: Sputter deposition processes, PVD and CVD methods of surface coatings, surface modification by ion implantation and ion beam mixing

Unit-V

Coating: Characterization of the engineered surface and coatings like thickness, porosity and adhesion of coatings, surface microscopy and spectroscopic analysis of the modified surfaces. Functional coatings and their applications.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understanding of surface structure and surface engineering basics.
- Understanding basics of wear and corrosion problems
- Understanding the contrasts between different group of surface engineering processes.

- Industrial applications of different surface engineering technique.

Text books:

- Surface Engineering & Heat Treatment By: P.H Morton I.I.T, Brooke field, (1991).

Reference books:

- Metals Handbook Ninth Edition, Vol.5, Surface Cleaning, Finishing & Coating, ASM, Metals Park Ohio, 1982..
- Corrosion Engineering By: M.G. Fontana, M.C. Graw Hill, N. York, 1987.

Online links for study & reference materials:

http:// //nptel.ac.in/courses/112/107/112107248/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Dissertation Phase – I

Teaching Scheme **Paper Code: MTC03**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ASME journals in the areas of design, thermal and production engineering area and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

SEMESTER-IV

DETAILED CURRICULUM CONTENTS

Dissertation Phase – II

Teaching Scheme **Paper Code: MTC04**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- ➢ Relevance to social needs of society
- ➢ Relevance to value addition to existing facilities in the institute
- ➢ Relevance to industry need
- ➢ Problems of national importance
- ➢ Research and development in various domain

The student should complete the following:

- ➢ Literature survey Problem Definition
- ➢ Motivation for study and Objectives
- ➢ Preliminary design / feasibility / modular approaches
- ➢ Implementation and Verification
- ➢ Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- ➢ Experimental verification / Proof of concept.
- ➢ Design, fabrication, testing of Communication System.
- ➢ The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – II:

- ➢ As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- ➢ The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ASME journals in the areas of design, thermal and production engineering area and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Software Engineering

Program Outcomes (POs)

Students will be able to

1. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like wireless communication, networking, measurements and standards in communication.

3. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

4. Ability to design and conduct experiments, analyze and interpret data, imbibe programming skills for development of simulation experiments.

5. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPCT1	Programming in Java	3	0	0	40	60	100	3
SPCT2	Advanced Data Structures	3	0	0	40	60	100	3
SPCL1	Programming in Java Lab	0	0	4	40	60	100	2
SPCL2	Advanced Data Structures Lab	0	0	4	40	60	100	2
Total							**400**	**10**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPCT3	Advanced algorithm	3	0	0	40	60	100	3
SPCT4	Soft Computing	3	0	0	40	60	100	3
SPCL3	Advanced algorithm Lab	0	0	4	40	60	100	2
SPCL4	Soft Computing Lab	0	0	4	40	60	100	2
Total							**400**	**10**

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPC1x	**Program Elective I** 1.Machine Learning 2.Aspect oriented SE 3. Introduction to Intelligent Systems 4.Advanced DBMS	3	0	0	40	60	100	3
SPE2x	**Program Elective II** 1. Data Science 2.Distributed Systems 3. Advanced Wireless and Mobile Networks 4. Advanced Software Engineering	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
MACO1	Audit Course-1	2	0	0	40	60	100	0
Total							**800**	**18**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPE3x	**Program Elective III** 1. Data Preparation and Analysis 2. Secure Software Design & Enterprise Computing 3. Computer Vision 4. Advanced operating system	3	0	0	40	60	100	3
SPE4x	**Program Elective IV** 1. Human and Computer Interaction 2. GPU Computing 3. Digital Forensics 4. Component Based SE	3	0	0	40	60	100	3
MACO2	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	2	100	0	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-5								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPE5x	Program Elective-V 1. Mobile Applications and Services 2. Compiler for HPC 3. Optimization Techniques 4. Object Oriented SE	3	0	0	40	60	100	3
MOE0x	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-6								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective
MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

DETAILED 3-YEAR CURRICULUM CONTENTS

Software Engineering

Course Code: SPCT1 **Course Name:** Programming in Java
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
- Read and make elementary modifications to Java programs that solve real-world problems.
- Validate input in a Java program.
- Identify and fix defects and common security issues in code.

Course Description:

The fundamentals of Java Programming are taught in this course. The contrast between classical and object-oriented programming will be examined, with emphasis on the latter. The latest additions to the Java language specification will be additionally covered. A comparison between C++ and Java will also be discussed, to develop an appreciation of the rationale for the emergence of these two object-oriented languages

Course Contents:

Unit-I Introduction: Introduction to Java - Features of Java - Object Oriented Concepts - Lexical Issues - Data Types - Variables - Arrays - Operators - Control Statements.

Unit-II Class: Classes - Objects - Constructors - Overloading method - Access Control- Static and fixed methods - Inner Classes - String Class - Inheritance - Overriding methods - Using super-Abstractclass.

Unit-III Packages: - Access Protection - Importing Packages - interfaces - Exception Handling - Throw and Throws - Thread - Synchronization - Messaging - Runnable Interface - Inter thread Communication - Deadlock - Suspending, Resuming and stopping threads - Multithreading.

Unit-IV I/O Streams: I/O Streams - File Streams - Applets - String Objects - String Buffer - Char Array - Java Utilities - Code Documentation.

Unit-V Socket Programming: Networks basics - Socket Programming - Proxy Servers - TCP/IP Sockets - Net Address - URL -Datagrams - Working with windows using AWT Classes - AWT Controls - Layout Managers and Menus.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Summarize the strengths and weaknesses of Java programming and the basic concepts of object-oriented programming.
- Identify Java code utilities in applets, Java packages, and classes.
- Write Java code using advanced Java features.

Text books:

- Cay S.Horstmann, Gary Cornell - Core Java 2 Volume I Fundamentals,5th Edn. PHI,2000.
- P. Naughton and H. Schildt - Java2 (The Complete Reference) - Third Edition,TMH 1999.

Reference books:

- K. Arnold and J. Gosling - The Java Programming Language - Second Edition, Addison Wesley, 1996.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105191/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCT2 **Course Name:** Advanced Data Structure

Course Credit Hour: 3hr **Total Contact Hour:** 32hr

Course Objective:

 The course is intended to provide the foundations of the practical implementation and usage of Algorithms and Data Structures. Main aim is to ensure that the student evolves into designing and analyzing of advanced algorithms and data structures for different kinds of problems. The second objective is to expose the student to the advanced algorithm and analysis techniques.

Course Description:

- This course builds on the first year Design and Analysis of Algorithm course. It introduces students to a number of highly efficient algorithm and data structure for fundamentals computational problems across the variety of areas. Students are also introduced to techniques such as Hashing, Skip Lists, Text Processing and Computational Geometry.

Course Contents:

Unit 1 Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing,Rehashing, Extendible Hashing.

Unit 2
Skip Lists**:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3
Trees**:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4
Text Processing**:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), applying dynamic Programming to the LCS Problem.

Unit 5
Computational Geometry**:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit 6
Recent Trends in Hashing, Trees, and various computational geometry methods for efficientlysolving the new evolving problem

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1**: Able to understand and apply various hashing techniques on different set of data.
- **CLO-2**: Able understand and apply various skip list operations on various data structure elements.
- **CLO-3**: Able to understand and apply various computational geometrical methods like Two Dimensional Range Searching, Priority Search Tree, Quadtrees, and k-D Trees on various data.
- **CLO-4**: To apply various data storage algorithms on data like, BST, Red Black Tree, and Splay Tree.

Text books:

- S. Dasgupta , C.H Papadimitriou and U.V. Vazirani, Algorithms, MaGraw-Hill.
- Thomas Core Man and Ronald Rivest, Introduction to algorithms, Mcgraw-Hill

Reference books:

- J.Kleinberg and E.Tardos, Algorithm Design, Addision –Wesly

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC11 **Course Name:** Machine Learning

Course Credit Hour: 3hr **Total Contact Hour:** 32hr

Course Objective:

- The course aims to provide basic understanding of issues and challenges of Machine Learning. It aims to train the student to the basic and advanced models and algorithms of the core field of machine learning. This course also involves understanding of the strengths and weaknesses of many popular machine learning approaches.

Course Description:

- The course covers the basic concepts and techniques of Machine Learning from both theoretical and practical perspective. The material includes Introduction to machine learning and different types of learning, Linear Regression, Decision Trees, Instance based learning, Feature Selection, Neural Network, Clustering and Support Vector Machines. The students will be able to understand almost all algorithms required to develop ML applications.

Course Contents:

Unit-1: Introduction to machine learning and different types of learning: Brief Introduction to Machine Learning; Definition, Components of a learning problem, Applications, Choosing a Model Representation, Types of learning: Supervised Learning, Unsupervised Learning, Semi-supervised learning, Reinforcement Learning, Inductive Learning or Prediction,

Unit-2: Linear Regression and Decision Trees, Instance based learning and Feature Selection: Regression, Types of Regression Models (Linear Classification, Logistic Regression, Components Regression, Bias – Variance Linear Regression Multivariate Regression etc), Dimensionality Reduction Subset Selection, Shrinkage Methods, Principle Linear Discriminant Analysis Optimization, Classification-Separating Hyperplanes Classification, LMS Algorithm, Decision Tree, Over fitting, Instance- Based Learning, Basic k-nearest neighbor classification, kNN, Euclidean Distance, Feature Reduction in ML, Subset selection, Feature extraction, PCA

Unit-3: Probability and Bayes Learning, Support Vector Machines, Clustering: Probability for Learning, Bayes Theorem, MAP Learner, Naïve Bayes, Bayesian Network, Logistic Regression for classification, Support Vector Machines, Unsupervised learning, Partitioning Algorithms, Hierarchical Clustering, Density based Clustering, K-means algorithm.

Unit-4: Neural Network: Neuron, ANNs, Perceptrons, Gradient Descent, Early models, Back propagation, Initialization, Training & Validation, Parameter Estimation (Maximum Likelihood Estimation, Bayesian Parameter Estimation) Decision Trees Evaluation Measures, Hypothesis Testing Ensemble Methods, Graphical, Deep Learning, Deep Neural Network, Hierarchical Representation, Unsupervised Pre-training, Activation Functions.

Unit-5: Clustering, Gaussian Mixture Models, Spectral Clustering Ensemble Methods Learning Theory, Reinforcement Learning.

Course Learning Outcomes (CLOs):

On completion of the course students will be expected to

- **CLO-1**: Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity etc,
- **CLO-2**: Have an understanding of the strength and weaknesses of many popular machine learning approaches.
- **CLO-3**: Appreciate the underlying mathematical relationship within and across Machine Learning Algorithms and the paradigm of supervised and un-supervised learning.
- **CLO-4**: Be able to design various machine learning algorithms in a range of real world applications.

Text books:

- Alpaydin E, Machine Learning, MIT Press.
- Bishop C, Pattern Recognition and Machine Learning, Springer-2006.
- Duda R, Hart E and Stork D, Pattern Classification, Wiley-Interscience.
- Mitchell T, Machine Learning, McGraw-Hill.

Reference books:

- Hastie T, Tibshirani R and Friedman J, Elements of Statistical Learning, Springer-2017.
- T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e,
- Christopher Bishop. Pattern Recognition and Machine Learning. 2e.

Online links for study & reference materials:

https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Mid-Term Exam)	- 20%
Assignment-3	- 05%
Assignment-1/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC12 **Course Name:** Aspect oriented Software Engineering

Course Credit Hour: 3 **Total Contact Hour**: 32

Course Objective: Learn new skills in software development which allow you to develop significantly more flexible software. Acquire a working understanding of AOP through the use of AspectJ. Acquire a clear understanding of the adaptive object-oriented paradigm through five architectural patterns; Structure-Shy Traversal, Selective Visitor, Structure-Shy Object, Class Graph and Growth Plan. Apply the aspect-oriented paradigm and the adaptive object-oriented paradigm to problems solving, including the implementation of a project. Understand the connections between the adaptive object-oriented approach and the aspect-oriented approach and how they fit into generative programming.

Course Description: This course provides state-of-the-art techniques and concepts for software development with a focus on proper separation of concerns. We will review the history of software development and encounter different techniques for separation of concerns like functions and objects. We will identify limitations in current software development practice that lead to bad separation of concerns. We will touch on general-purpose aspect-oriented techniques (AspectJ) that lead to better separation of concerns. Then we will identify limitations in those general-purpose techniques and point to special purpose aspect-oriented techniques. We will use the Demeter Method as an example of a special purpose aspect-oriented technique.

This course introduces both the aspect-oriented and adaptive approach to software development and compares them to other approaches in the context of Generative Programming. Loose coupling between software artifacts is a theme used throughout the course. Specifically, we will learn about loose coupling between structure and behavior which leads to adaptiveness. Adaptive programming views "structure" as an aspect which crosscuts behavior. We will also look at many other aspects such as synchronization and remote invocation. We will study the basic concepts of aspect-oriented programming (an AOP system has five key ingredients) and how they relate to the concepts of adaptive programming.

Course Contents:

UNIT 1: Introduction to Aspect Oriented Paradigm, Introduction to Software Architecture, Architecture models - 4+1 views, Architecture.

UNIT2: Definition Language, Evolution – Model Driven Architecture, Component Based architecture, Service Oriented Architecture, Event Driven Architecture, Architecture models .

UNIT3: Coding Standards and Guidelines, Code reviews & Walkthroughs, Coding Principles, Code reuse ,Program analysis – slicing and merging, Correctness proof, Symbolic execution, Formal Verification Software testing objectives and principles, Verification vs. Validation, Types of testing, Cyclomatic complexity, Test Case Generation, Test tools & Models, Object-oriented Testing, Model Based testing, Test automation.

UNIT4: Software Quality Assurance and Quality control, Software Process Control, Quality factors, Quality standards – TQM, ISO, SEI CMM, PCMM, Six sigma, Reliability, Hazard, Availability, Steady State Availability, Estimation of Residual Errors, Reliability Models.

UNIT5: Software Project Management concepts, Software Project Management Plan, Tools for project plan – WBS, PERT, GANTT, Project Scheduling & Monitoring, Risk Management, Software Project Complexity, Estimation Metrics –Size Oriented and Function Point Oriented; Cost Estimation - Algorithmic Cost Modeling, COCOMO Model (including COCOMO II and advanced COCOMO), Personnel Productivity & team structure [6L]

UNIT6: Software Metrics, Significance, Project, process and product metrics, Halstead's metrics, OO metrics –Performance Metrics, Defect Metrics Software maintenance and types, Software reengineering process model; Computer Aided Software Engineering,, building blocks for CASE, Taxonomy of CASE tools

Text Books

1. Aspect-Oriented Software Development by Robert E. Filman , Tzilla Elrad , Siobhán Clarke , Mehmet Aksit
2. Aspect-Oriented Software Development Ivan Kiselev

Online links for study & reference materials

1. NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPC13 **Course Name:** Introduction to intelligence system

Course Credit Hour: 3 **Total Contact Hour**: 32

Course Objective:

- Demonstrate good knowledge of basic theoretical foundations of the following common intelligent systems methodologies: - Rule-based systems - Fuzzy inferencing - Artificial neural networks - Evolutionary computation - Data Mining 2 - Case-based reasoning - Probabilistic reasoning - Intelligent agents

- Determine which type of intelligent system methodology would be suitable for a given type of application problem

- Demonstrate, in the form of a major project work, the ability to design and develop an intelligent system for a selected application.

Course Description:

This course introduces students to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach. It explores the essential theory behind methodologies for developing systems that demonstrate intelligent behavior including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Course Contents:

UNITI

(Introduction to AI, Intelligent Agents and Searching) Definition of AI, birth of AI, brief history, Turing test, Types of environment, Types of agents, PEAS (Performance measure , Environment, Actuators, Sensors), Introduction to searching, State Space, SAGP (State, Action, Goal test, Path cost), DFS, BFS (Completeness, Time complexity, Space complexity, Optimality), Heuristics, Local Search Algorithm, Hill Climbing.Applications of Artificial Intelligence in real word.

Unit II

(CSP, Game Playing and Logics) Constrain Satisfaction Problems examples, Approaches to solve CSPs, Test and generate method, back tracking. Game Playing, Optimal decision in games, Min Max algorithm, Evaluation functions, Introduction to Propositional Logic and First Order Logic, Syntax, Substitution, Unification, Deduction, Soundness, Completeness, Consistency, Satisfiability, Expert Systems.

Unit III

(Uncertain Knowledge, Reasoning and Machine Learning) Probabilistic Reasoning, Review of Probability Theory, Probabilistic Inference Rules, Bayes Theorem,examples of Bayes theorem, Introduction to Learning, Taxonomy of Learning Systems,Concept Learning, Find-S algorithm, Candidate Elimination Algorithm.Introduction to Neural Networks, Biological Neural Networks, Artificial Neural Networks, Perceptron, Perceptron Learning Rule, Delta Rule,Applications of Neural Networks.

Course Learning Outcomes (CLOs):

CO1:Understand concepts of Artificial Intelligence and different types of intelligent agents and their architecture.

CO2:Formulate problems as state space search problem & efficiently solve them.

CO3. Understand the working of various informed and uninformed searching algorithms and different heuristics

CO4:Understand concept of knowledge representation i.e. propositional logic, first order logic.

CO5:Reasoning with uncertainty and Machine learning algorithms.

CO6: Understand how learning happens in neural networks.

Text Books

1. Stuart Russell and Peter Norvig – Artificial Intelligence A Modern Approach, PEARSON Education.

2. Simon Haykin -Neural Networks PHI.

Reference Books

1. N. P. Padhy – Artificial Intelligence and Intelligence Systems, OXFORD publication.

2. B. YagnaNarayana - Artificial Neural Networks, PHI

Online links for study & reference materials

1. NPTEL Lecture: Prof. SudeshnaSarkar, http://nptel.ac.in/courses/106105077/

2. NPTEL Lecture: Prof. P.Das Gupta, http://nptel.ac.in/courses/106105079/

3. NPTEL Lecture: Prof. Deepak Khemani, http://nptel.ac.in/courses/106106126/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPC14

Course Name : Advanced Database Management System

Course Credit Hour : 3

Total Contact Hour : 32hr

Course Objective:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data ware housing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Course Description:

Focuses on concepts and structures necessary to design and implement a database management system. Various modern data models, data security and integrity, and concurrency are discussed. An SQL database system is designed and implemented as a group project.

Course Contents:

Module I Formal review of relational database and FDs Implication, Closure, its correctness

Module II 3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans.

Module III Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, Serializability.

Module IV Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC.

Module V T/O based techniques, Multi version approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases

Course Learning Outcomes (CLOs):

CLO1. For a given query write relational algebra expressions for that query and optimize the developed expressions

CLO2. For a given specification of the requirement design the databases using E R method and normalization.

CLO3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.

CLO4. For a given query optimize its execution using Query optimization algorithms

CLO5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

CLO6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Text books :

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts” , 6th Edition, McGraw-Hill, 9780078022159, 0078022150.

Reference books :

1 J. D. Ullman, “Principles of Database and Knowledge – Base Systems”, Vol 1, Computer SciencePress, 788175155459, 8175155450

2 R. Elmasri and S. Navathe, “Fundamentals of Database Systems” , 5th Edition, PearsonEducation 9788131716250, 8131716252

3 Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley “Foundations of Databases”, 9780201537710.

Online links for study & reference materials:

https://www.geektonight.com/database-management-systems-notes-pdf

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE2X **Course Name:** Data Science

Course Credit Hour: 3 ` **Total Contact Hour**: 36hr

Course Objective:

- Obtain, clean/process, and transform data
- Analyze and interpret data using an ethically responsible approach
- Use appropriate models of analysis, assess the quality of input, derive insight from results, and investigate potential issues
- Apply computing theory, languages, and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses
- Formulate and use appropriate models of data analysis to solve hidden solutions to business-related challenges
- Perform well in a group
- Interpret data findings effectively to any audience, orally, visually, and in written formats

Course Description: Get a solid basis in the informatics and statistical methodology necessary for working within Data Science.

Course Content:

Unit I Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit II Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

Unit III Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit IV Data visualisation: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Unit V Applications of Data Science, Technologies for visualisation, Bokeh (Python), recent trends invarious data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Course Learning Outcomes (CLOs):

CLO1: Develop relevant programming abilities.

CLO2: Demonstrate proficiency with statistical analysis of data.

CLO3: Develop the ability to build and assess data-based models.

CLO4: Execute statistical analyses with professional statistical software.

CLO5: Demonstrate skill in data management.

CLO6: Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.

Textbooks:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013.

References:

1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014.

Online links for study & reference materials:

https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam) -	20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PEC-CS-S 602 **Course Name:** Distributed Systems

Course Credit Hour: 3 **Total Contact Hour**: 40hr

Course Objective: To provide hardware and software issues in modern distributed systems.

• To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

• To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

Course Description: This course provides a hands-on the challenges faced in constructing client/server software: partial system failures, multiple address spaces, absence of a single clock, latency of communication, heterogeneity, absence of a trusted operating system, system management, binding and naming. Techniques for meeting these challenges: RPC and middleware, naming and directory services, distributed transaction processing, 'thin' clients, data replication, cryptographic security, mobile code. Introduction to Java RMI.

Course Contents:

Unit I Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. TheoreticalFoundation for Distributed System: Limitation of Distributed system, absence of global clock,shared memory, Logical clocks, Lamport's& vectors logical clocks. Concepts in Message PassingSystems: causal order, total order, total causal order, Techniques for Message Ordering, Causalordering of messages, global state, termination detection.

Unit II Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement ofmutualexclusion theorem, Token based and non-token-based algorithms, performance metric fordistributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resourceVs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralizeddead lock detection, distributed dead lock detection, path pushing algorithms, edge chasingalgorithms.

Unit III Agreement Protocols: Introduction, System models, classification of Agreement Problem,Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution toByzantine Agreement problem, Application of Agreement problem, Atomic Commit in DistributedDatabase system. Distributed Resource Management: Issues in distributed File Systems,Mechanism for building distributed file systems, Design issues in Distributed Shared Memory,Algorithm for Implementation of Distributed Shared Memory.

Unit IV Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems.Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Unit V Transactions and Concurrency Control: Transactions, Nested transactions, Locks, OptimisticConcurrency control, Timestamp ordering, Comparison of methods for concurrency control.Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Course Learning Outcomes (CLOs):

CO1: To provide hardware and software issues in modern distributed systems.

CO2: To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.

CO3: To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

CO4: To know about Shared Memory Techniques.

CO5: Have Sufficient knowledge about file access.

Text books:

1. Singhal&Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill

2. Ramakrishna,Gehrke,” Database Management Systems”, McGraw Hill

3. Vijay K.Garg Elements of Distributed Compuitng , Wiley

4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design”, PearsonEducation

5. Tenanuanbaum,Steen,” Distributed Systems”, PHI

Reference books:

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.

2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman&Hall/CRC, Taylor &Fransis Group, 2007.

Online links for study & reference materials:

1. https://www.ncertbooks.guru/computer-graphics-notes/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE23 **Course Name:** Advanced wireless & mobile Networks

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective: Signal Processing For Wireless Communication is a course offered to 1st semester M.Tech in Wireless Networks & Applications. It provides an insight into signals and system and their significance in Wireless Communication.A thorough understanding of digital signal processing fundamentals and techniques is essential for anyone whose work is concerned with signal processing applications in Wireless Communication. Digital Signal Processing begins with a discussion of the analysis and representation of discrete-time signal systems, including discrete-time convolution, difference equations, the z-transform, and the discrete-time Fourier transform. Emphasis is placed on the similarities and distinctions between discrete-time. The course proceeds to cover digital network and nonrecursive (finite impulse response) digital filters. Digital Signal Processing concludes with digital filter design and a discussion of the fast Fourier transform algorithm for computation of the discrete Fourier transform. MATLAB demos and simulation assignments will aid the students to get a deeper understanding about the concept of Signal Processing in Wireless Communication.

Course Content:

UNIT -I The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference, Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring.

UNIT –II Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- LongleyRyce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III Mobile Radio Propagation: Small –Scale Fading and Multipath: Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV Equalization and Diversity: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Nonlinear Equalization- Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
4. ~~4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012~~

REFERENCES:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.

2. Wireless Communication and Networking – William Stallings, 2003, PHI

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE24 **Course Name:** Advanced Software Engineering

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- To provide an advanced understanding and knowledge of the software engineering techniques, techniques to collect software requirements from client, testing , design and CASE tools and to understand the importance of these case tools in software development

Course Description:

- The course introduces advanced concepts in advanced software engineering including Introduction, Software Requirement Specification, Architecture and Design, Testing and CASE study. Not only do they form basic models of computation, they are also the foundation of many branches of computer science.

Course Contents:

UNIT-1 Introduction: Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT-2: Software Requirement Specification: Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT-3 Architecture and Design: Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client- server - Tiered - Pipe and filter.- User interface design.

UNIT-4: Testing: Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

UNIT-5: DEVOPS: DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Micro services.

Course Learning Outcomes (CLOs):

- CLO-1: Analyze the software life cycle models
- CLO-2: Identify the importance of the software development process
- CLO-3: Able to understand business requirements pertaining to software development.
- CLO-4: Analyze the importance of CASE tools
- CLO-5: Able to understand business requirements pertaining to software development.

Text books:

- Roger S. Pressman, Software Engineering a Practitioners Approach, McGraw-Hill.
- J. Bowan, Formal Specification and Documentation using Z - A Case Study Approach, International Thomson Computer Press.
- Antoni Diller, Z., an Introduction to Formal Methods, Wiley.

Reference books:

- M. Dyer, The Cleanroon Approach to Quality Software Development, Wiley.
- Prowell, S., Trammell, C.J. and Poore, J.H, Cleanroom Software Engineering: Technology and Process, Addison-Wesley.

Online links for study & reference materials:

1. https://nptel.ac.in/courses/106/105/106105182/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: MTC01 **Course Name**: Research Methodology and IPR

Course Credit: 2 **Total Contact Hour** : 20 hr

Course Objective :

- Identify an appropriate research problem in their interesting domain
- To explain various research designs and their characteristics
- To explain the art of interpretation, art of writing research reports and presentation skills
- To explain various forms of intellectual property, its relevance and business impact in the changing global business environment

Course Description:

This course emphasizes on the fundamental of research. The student first taught about research formulation and then what are the research designs needed according to research formulation. To understand and formulate the research problem the student should be aware of the aspect of effective literature review and the sources of information.to be taken to conduct literature review. Students are exposed to application of research design through which they understand that how, when and which design is required.In concurrence with this , the analysis part will be taught. Finally concepts related to patents, trademark and copyright will be taught.

Course Content:

UNIT 1: Meaning of research problem, sources of research problem, characteristics of good research problem, errors in selecting a research problem, scope and objectives of research problem. Appraches of investigation of solutions for research problem, data collection, analysis, interpretation. Necessary instrumentation

UNIT 2: Effective literature studies approaches, analysis, plagiarism and research ethics

UNIT-3 Effective technical writing, how to write report, paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT -4 Nature of Intellectual property; patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development, International Scenario; International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-5 Patent Rights; Scope of Patents Rights, Licensing and transfer of technology; Patent information and databases, geographical Indications.

UNIT-6 New development in IPR, Administrationof patent system, New developments in IPR, IPR of Biological system, Computer software etc. Traditional knowledge case studies, IPR and IITs.

Course Learning Outcomes (CLOs):

- Understand the characteristics, objects of good research problem.
- Understand concepts of data collection, analysis
- Understand significance, effective technical writing and report
- Understand the patent rights and transfer of technology

Text books:

- Stuart Melville and Wayne Goddard,’’ Research methodology: an introduction for science and engineering student’’
- Wayne Goddard and Stuart Melville, ‘’ Research Methodology: An Introduction’’

Reference books:

- Ranjit Kumar, 2ndEdition,’’Research Methodology: A step by step Guide for beginners’’
- Halbert, ‘’ Resisting Intellectual Property’’, Taylor and Francis Ltd, 2007
- Mayali,’’ Industrial Design’’, McGraw Hill, 1992.

Online links for study and reference materials:

1. https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MAC01 **Course Name:** Value Education

Course Credit Hour: 2hr **Total Contact Hour:** 25hr

Course Objective:

1. To make students understand the relevance of individual values in everyday lives
2. To help students imbibe different individual values in their personality
3. To help students develop good moral values and positive character
4. To help students learn the significance of self management and self-control

Course Description:

The course is an appropriate combination of theoretical and industry specific contents on values and works ethics aimed at developing students into professionals. The course enables students learn concepts related to values and description of different types of values like individual values, social values, organizational values, etc. The course emphasizes on significance of cultivation of individual values that are essential in a personality and lists out various individual values to be imbibed in a student preparing for professional world. The course also describes various practical aspects of value education like managing good health, self-control, science of reincarnation, religious tolerance and role of women, which are pre-requisites for good moral character and competence.

Course Contents: The course is divided into 4 broad units namely:

Unit-1: Values and Self-development, Social Values and Individual attitudes, work ethics and Indian vision of humanism, moral and non-moral valuation, standards and principles, valuejudgments,

Unit-2: Importance of cultivation of values, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanlinesss, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline.

Unit-3: Personality and Behaviour Development, soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, freedom from anger, dignity of labour, universal brotherhood, religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature.

Unit-4: Character and Competence, holy book vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind your self, self-control, honesty, studying effectively

Course Learning Outcomes (CLOs):

CLO-1: The students will be able to relate to concepts related to value education in their everydaylives.
CLO-2: The students will be able to demonstrate individual values cultivated in their respective workplaces or professional world.
CLO-3: The students will be able to differentiate between the different types of values and imbibe them as part of their self-development.
CLO-4: The students will be able to learn and practice techniques of managing good health, self- control, gender sensitivity and religious tolerance.

Text books:

1. Indrani Majhi, Ganesh Das, VALUE EDUCATION, 1, 2017, Laxmi Publications Pvt Ltd, ISBN: 9789352741120, 9352741129
2. Sharma Sandeep, Encyclopedia of Indian Ethos and Values in Management, Anmol Publications Pvt Ltd, ISBN: 9788126139187, 9788126139187

Reference books:

1. UN-HABITAT, Human Values And Ethics In Workplace: Improving Leadership And Performance In The Water Education, Water Supply And Sanitation Sector, 2006, United Nations Human Settlements Programme (UN-HABITAT)
2. Ganesh A. Gayatri, Values Attitude and Practices, Publisher: Discovery Publishing Pvt. Ltd, ISBN: 9789350561287, 9789350561287
3. Atkinson Camille E., Women, Ethics and the Workplace, ABC-CLIO, ISBN: 9780275960919,9780275960919
4. Green Connie Ragen, Rethinking the Work Ethic, Hunter's Moon Publishing, ISBN: 9781937988333, 9781937988333

Online links for study & reference materials:

1. https://www.researchgate.net/publication/228079327
2. https://www.researchgate.net/publication/49586890
3. https://www.researchgate.net/publication/258040203
4. https://www.enterpreneur.com/amphtml/310254
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705678

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment -1	-05%
Assignment-2	- 05%
Assessment-3(Mid-term exam)	- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCL1 **Course Name:** Programming In Java Lab

List of Experiments

1. To print the even and odd number between 1 to 20.
2. To print the input data by using buffered Reader.
3. Find the greatest and smallest number in an array.
4. To calculate area of triangle using constructors.
5. Write a program for Method Overriding and Method Overloading.
6. To find the area of circle using abstract class
7. Write a program in threads that implements Runnable interface.
8. Write a program to compare to strings using string handling.
9. Write a program of applets that inserts image “A.jpg”.
10. Write a program in applet to make a human face.
11. Create text area, Button, Scrollbar & Menu using AWT.
12. Program to implement package and implement it.

Course Code: SPCL2 **Course Name:** Advanced Data Structure Lab

S.No	Name of Experiment
1	Write a program in C to implement following operations for Binary Search Tree ➢ Insertion ➢ Deletion ➢ Create Node ➢ In order Traversal
2.	WAP IN C for AVL Tree to implement following operations: (For nodes as integers) ➢ Create a node ➢ Right Rotate ➢ Left Rotate ➢ Get the balance factor ➢ Insert Node ➢ Delete a node ➢ Update a balance factor Print the tree
3.	WAP in python to perform string matching using Rabin-Karp algorithm.
4.	WAP to perform string matching using Knuth-Morris-Pratt algorithm.
5.	WAP in python to perform string matching using naive algorithm.
6.	Write a program in python to perform following operations on dictionaries ➢ Creating Dictionary ➢ Traversing of Dictionary(using for loop)
7.	Write Python Program to Count the Number of Characters in a string using dictionaries. Display the Keys and their values in alphabetical order.
8.	Write Python program to generate a dictionary that contains (i: i*i). Such that i is a number ranging from 1 to n.
9.	Write a program in python to Demonstrate Nested Dictionaries.
10.	Write a program in python which demonstrate working of hash.

Course Code: SPCT3

Course Name: Advanced Algorithm

Course Credit: 3

Total Contact Hour: 30hr

Course Objective:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course Description:

This course is concerned with the study of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. There will also be a brief introduction to complexity theory, the formal study of algorithm performance. A large variety of algorithms are candidates for study. These include, but are not limited to, the following: greedy algorithms, dynamic programming, network flow algorithms, algorithms for string matching, parallel algorithms, graph algorithms and approximation algorithms.

Course Contents:

Unit-I

Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge- weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example ofamortized analysis.

Unit-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations,LUP-decomposition

Unit-IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.
Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application:Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest
Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced NumberTheoretic Algorithm

Unit-VI

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Argue the correctness of algorithms using inductive proofs and invariants.
- Analyze worst-case running times of algorithms using asymptotic analysis.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.

Text books:

- Dasgupta, Sanjoy, Christos Papadimitriou, and Umesh Vazirani. *Algorithms*. McGraw-Hill, 2006. ISBN: 9780073523408.
- Kleinberg, Jon, and Eva Tardos. Algorithm Design. Addison-Wesley, 2005. ISBN: 9780321295354.

Reference books:

- Even, Shimon. Graph Algorithms. Computer Science Press, 1979. ISBN: 9780914894216.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105157/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPCT4 **Course Name:** Soft Computing

Course Credit Hour: 4hr **Total Contact Hour:** 35hr

Course Objective:

- The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.
- Upon successful completion of the course, students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning.
- Provide the mathematical background for carrying out the optimization associated with neural network learning.

Course Description:

- The course introduces fundamental concepts in Soft Computing including Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Deep Learning. The properties of these concepts will be studied and various rigorous techniques for analyzing and comparing them will be discussed and implemented by using Python and MATLAB.

Course Contents:

Unit-1 INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to ComputationalIntelligence: Machine Learning Basics.

Unit-2 FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems,Fuzzy Decision Making.

Unit-3 NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.

Unit-4 GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit-5 Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

Unit-6 Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Course Learning Outcomes (CLOs) :

Students will be able to**:**

- CLO-1: Describe human intelligence and AI Explain how intelligent system works.
- CLO-2: Apply basics of Fuzzy logic and neural networks.
- CLO-3 : Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- CLO-4 : Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
- CLO-5: Implement Fuzzy logic and ANN methods using Python/MATLAB.

Text books:

- J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education.
- Simon O. Haykin “Artificial Neural Network”, PHI.
- Elaine Rich, Kevin Knight, Artificial Intelligence, TMH.

Reference books:

- Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill.
- Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley.
- S. Rajasekaran and G.A.V.Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/105/106105173/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE31 **Course Name:** Data Preparation & Analysis

Course Credit Hour: 3hr **Total Contact Hour:** 35hr

Course Objective:

- Recognize the relative impact of data quality and size to algorithms.
- Set informed and realistic expectations for the time to transform the data.
- Explain a typical process for data collection and transformation within the overall ML workflow.
- Collect raw data and construct a data set.
- Sample and split your data set with considerations for imbalanced data.
- Transform numerical and categorical data.

Course Contents:

Unit I : Data Gathering and Preparation: Data formats, parsing and transformation, Scalability andreal-time issues.

Unit II : Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformationand segmentation.

Unit III: Exploratory Analysis: Descriptive and comparative statistics, Clustering and association,Hypothesis generation.

UnitIV : Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity.

Unit V: Visualizations using R

Course Learning Outcomes (CLOs) :

CLO1: Engage in continuous reflective learning in the context of technology and scientific advancement.

CLO2: Identify the need and scope of the Interdisciplinary research.

CLO3: Enhance research culture and uphold the scientific integrity and objectivity

CLO4: Understand the professional, ethical and social responsibilities

CLO5: Understand the importance and the judicious use of technology for the sustainability of the environment

CLO6: Enhance disciplinary competency, employability and leadership skills.

Text books:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.

Online links for study & reference materials:

1. NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5/Quiz	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE32 **Course Name :** Secure Software design & enterprise computing

Course Credit Hour : 3 **Total Contact Hour :** 30hr

Course Objective: Students will learn that how the security aspects of software development are embedded into the system to be developed. It includes secure architecture design, secure coding, secure deployment and secure software development methodologies.

Course Contents:

Unit-I Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, Perform security testing and quality assurance.

Unit –II Enterprise Application Development: Describe the nature and scope of enterprise software applications, Design distributed N-tier software application, Business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Present software solution.

Unit –III Enterprise Network Management: Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them, Handle insecure exceptions and command/SQL injection, Defend web and mobile applications against attackers, software containing minimum Vulnerabilities and flaws.

Unit –IV Enterprise Systems Administration: Design, implement and maintain a directorybased server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).

Unit –V Software Security in Business Enterprise: Identification and authentication, Enterprise Information Security, Symmetric and asymmetric cryptography, Access control models, Kerberos protocol, Protocols specially designed for e-commerce and web applications, firewalls and VPNs. Management issues, technologies, and systems related to information security management at enterprises.

Unit –VI Case Studies: Case study of DNS server, Case study on DHCP configuration and Case study on SQL injection attack, Case study on Terminal services.

Course Learning Outcomes (CLOs):

1. Differentiate between various software vulnerabilities

2. Identify software process vulnerabilities for an organization

3. Monitor resources consumption in a software

4. Interrelate security and software development process

Text books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley
3. W. Stallings, Cryptography and network security: Principles and practice, Prentice Hall.

Reference books:

1. C. P. Pfleeger, S. L. Pfleeger, Security in Computing, Prentice Hall
2. Gary McGraw, Software Security: Building Security In, Addison-Wesley

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE33 **Course Name :** Computer Vision

Course Credit Hour: 3 **Total Contact Hour:** 30hr

Course Objective:
To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications

Course Contents:

UNIT1 :- Image Formation Models: Monocular imaging system, Orthographic& Perspective Projection, Camera model and Camera calibration, Binocular imaging systems

UNIT II:- Image Processing and Feature Extraction: mage representations (continuous and discrete), Edge detection.

UNIT III:- Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motionestimation, Structure from motion

UNIT IV :-Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi Resolution analysis

UNIT V:- Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component analysis, Shape priors for recognition.

Course Learning Outcomes (CLOs):

CLO1: Identify basic concepts, terminology, theories, models and methods in the field of computer vision.

CLO2: describe known principles of human visual system.

CLO3: describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.

CLO4: suggest a design of a computer vision system for a specific problem.

Text books:
1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Reference books:
1. Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)
2. Haralick& Shapiro, "Computer and Robot Vision", Vol II
. G_erardMedioni and Sing Bing Kang "Emerging topics in computer vision"
4. Emanuele Trucco and AllessandroVerri "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
5. Olivier Faugeras, "Three-Dimensional Computer Vision", The MIT Press, 1993.

Online links for study & reference materials:

1. NPTEL

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : SPE34

Course Name : Advanced Operating System

Course Credit Hour : 3

Total Contact Hour : 30hr

Course Objective:

- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management

Course Description:

- Covers the classical internal algorithms and structures of operating systems, including CPU scheduling, memory management, and device management.
- Considers the unifying concept of the operating system as a collection of cooperating sequential processes.
- Covers topics including file systems, virtual memory, disk request scheduling, concurrent processes, deadlocks, security, and integrity.

Course Contents:

ModuleI : FUNDAMENTALSOF OPERATING SYSTEMS

Overview – Synchronization Mechanisms , Processes and Threads , Process Scheduling , Deadlocks: Detection, Prevention and Recovery, Models of Resources, Memory Management Techniques.

ModuleII:DISTRIBUTEDOPERATING SYSTEMS

Issues in Distributed Operating System , Architecture , Communication Primitives , Lamport's Logical clocks, Causal Ordering of Messages, Distributed Mutual Exclusion Algorithms, Centralized and Distributed Deadlock Detection Algorithms, Agreement Protocols.

ModuleIII:DISTRIBUTEDRESOURCEMANAGEMENT

Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery, Fault Tolerance , Two-Phase Commit Protocol, Non blocking Commit Protocol , Security and Protection.

ModuleIV : REAL TIME AND MOBILE OPERATING SYSTEMS

Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems , Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management , File system.

ModuleV : CASE STUDIES

Linux System: Design Principles , Kernel Modules, Process Management Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication. iOS and Android: Architecture and SDK Framework , Media Layer, Services Layer, Core OS Layer, File System.

Course Learning Outcomes (CLOs):

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Text books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall ofIndia.

Reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison-Wesley
3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall ofIndia
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly andAssociates

Online links for study & reference materials:

1.NPTEL

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE41 **Course Name:** Human Computer Interaction

Course Credit Hour: 3 **Total Contact Hour:** 35hr

Course Objective:

- Provide an overview of the concepts relating to the design of human-computer interfaces in ways making computer-based systems comprehensive, friendly and usable.
- Identify the various tools and techniques for interface analysis, design, and evaluation.

Course Description:

Upon successful completion of this course, students should be able to:

- Design, implement and evaluate effective and usable graphical computer interfaces.
- Describe and apply core theories, models and methodologies from the field of HCI.
- Describe and discuss current research in the field of HCI

Course Contents:

Jnit 1 Introduction: Importance of user Interface – definition, importance of 8 good design. Benefits ofgood design. A rief history of Screen design. The graphical user interface – popularity of raphics,theconceptofdirectmanipulation,graphicalsystem,Characteristics,Webuser Interfacepopularity,characteristics- 'rinciples of user interface.

Unit 2 Designprocess: Human interaction with computers, importance of 8 human characteristics human consideration,Human interaction speeds,understanding business junctions.IIIScreen Designing:Design goals.

Unit 3 ScreenDesigning: Designgoals–Screenplanningandpurpose,8organizingscreenelements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition –amount of information – focus and emphasis – presentation information simply and meaningfully –informationretrievalonweb–statisticalgraphics–Technologicalconsiderationininterfacedesign.

Unit 4 Windows: New and Navigation schemes selection of window, 8 selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors ,uses problems, choosing colors.

Unit 5

Softwaretools: Specificationmethods,interface–BuildingTools.8InteractionDevices– Keyboardandfunctionkeys–pointingdevices–speechrecognitiondigitizationandgeneration–image and video displays –drivers.

Course Learning Outcomes (CLOs):

CLO1: Understand fundamental design and evaluation methodologies of human computer interaction.

CLO2: Demonstrate knowledge of human computer interaction design concepts and related methodologies.

CLO3: Apply theories and concepts associated with effective work design to real-world application

Text books:

1. AlanDix,JanetFinlay,GregoryAbowd,RussellBealeHumanComputer Interaction,3rdEditionPrenticeHall,2004.
2. JonathanLazarJinjuanHeidiFeng,HarryHochheiser,ResearchMethodsinHumanComputerInteraction,Wiley,2010.
3. BenShneidermanandCatherinePlaisantDesigningtheUserInterface:StrategiesforEffectiveHuman-ComputerInteraction(5thEdition,pp.672,ISBN0-321-53735-1,March2009),Reading,MA:Addison-WesleyPublishingCo.

Reference books:

1. "Human-Computer Interaction" by Dix
2. "Designing the User Interface: Strategies for Effective Human-Computer Interaction" by Shneiderman

Online links for study & reference materials:

https://guides.lib.uw.edu/research/hcid/hcid-rec

Assessment method:(Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE42 **Course Name:** GPU Computing

Course Credit Hour: 3hr **Total Contact Hour:** 32 hr

Course Objective: General Purpose Graphical Processing Units (GPGPU) primarily refers to the use of GPUs for computationally intensive mathematical and scientific computing. The enormous peak performance of GPUs for arithmetically intensive computations relatively at a much lower cost compared to CPUs makes GPU computing a very attractive new alternative for computationally demanding problems.

Course Description: Understanding the basic concepts of GPU programming, CUDA (Compute Unified Device Architecture) parallel computing platform and hands-on experience on implementing some standard CUDA programs. Finally the course will give a brief overview of the current applications and future trends of GPU computing in scientific research.

Course Contents:

- **Introduction** (2 + 1): History, graphics processors, graphics processing units, GPGPUs. Clock speeds, CPU / GPU comparisons, heterogeneity. Accelerators, parallel programming, CUDA / OpenCL / OpenACC,
- **Hello World Computation** (3 + 1) Kernels, launch parameters, thread hierarchy, warps / wavefronts, thread blocks / workgroups, streaming multiprocessors, 1D / 2D / 3D thread mapping, device properties, simple programs
- **Memory** (8 + 2) : Memory hierarchy, DRAM / global, local / shared, private / local, textures, constant memory. Pointers, parameter passing, arrays and dynamic memory, multi-dimensional arrays. Memory allocation, memory copying across devices. Programs with matrices, performance evaluation with different memories
- **Synchronization** (6 + 2): Memory consistency. Barriers (local versus global), atomics, memory fence. Prefix sum, reduction. Programs for concurrent data structures such as worklists, linked-lists. Synchronization across CPU and GPU
- **Functions** (3 + 1): Device functions, host functions, kernels, functors. Using libraries (such as Thrust), developing libraries.
- **Support** (1 + 2): Debugging GPU programs. Profiling, profile tools, performance aspects
- **Streams** (3 + 1): Asynchronous processing, tasks, task-dependence. Overlapped data transfers, default stream, synchronization with streams. Events, event-based-synchronization
  - overlapping data transfer and kernel execution, pitfalls.
- **Case studies** (3 + 2) : Image processing. Graph algorithms. Simulations. Deep learning.
- Advanced topics (8 + 2) : Dynamic parallelism. Unified virtual memory. Multi-GPU processing. Peer access. Heterogeneous processing

Course Learning Outcomes (CLOs):

CLO1: Describe common GPU architectures and programming models.

CLO2: Describe common GPU architectures and programming models

CLO3: Implement efficient algorithms for common application kernels, such as matrix multiplication.

CLO4: Given a problem, develop an efficient parallel algorithm to solve it.

CLO5**:** Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining your achievements.

Reference Books:

1. Programming Massively Parallel Processors: A Hands-On Approach, 2nd Edition, David Kirk and Wen-mei Hwu, Publisher: Morgan Kaufman, 2012, ISBN: 9780124159921

Online links for study & reference materials:

1. **MPI:** www.mcs.anl.gov/mpi/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE43 **Course Name:** Digital Forensics

Course Credit Hour: 3hr **Total Contact Hour:** 32 hr

Course Objective: Student can identify, analyze and remediate computer security breaches by learning and implementing the real-world scenarios in Cyber Investigations Laboratory, Network Security Laboratory and in Security and Penetration Testing Laboratory. Exhibit knowledge to secure corrupted systems, protect personal data, and secure computer

- Networks in an Organization.
- Understand key terms and concepts in Cryptography, Governance and Compliance.
- Develop cyber security strategies and policies
- Understand principles of web security and to guarantee a secure network by monitoring
- Analyzing the nature of attacks through cyber/computer forensics software/tools.

Course Description: Introduces computer security administrators to computer forensics. Includes setup and use of an investigator's laboratory, computer investigations using digital evidence controls, processing crime and incident scenes, performing data acquisition, computer forensic analysis, e-mail investigations, image file recovery, investigative report writing, and expert witness testimony.

Course Contents:

UNIT 1: Review of Computer Investigations

A. Case examination and assessment

B. Evidence gathering

C. Systematic approaches to computer investigations

D. Conducting an investigation

UNIT 2: Review Operating and File Systems

A. Review of file structures, boot processes, and data structures of popular operating systems.

B. NTFS

C. Macintosh

D. Linux

UNIT3: Preparing Media to Accept an Image

A. Create a partition

B. Wipe partition using DOD standard

C. Verify wipe of partition

UNIT4: Digital Forensics Evidence

A. Restoring a Hard Disk Image

B. Verifying restore was successful

C. Boot to the evidence Operating System

UNIT 5: Data Acquisition

A. Identify methods

B. Utilization of various data acquisition tools

UNIT6: Computer Forensic Analysis

A. Concepts

B. Utilization of various analysis tools

C. Recognizing, locating, recovering and analyzing images

D. Processing evidence with FTK E. Data Carving

F. Searching the Registry

UNIT 7: Linux Forensics

A. Linux Distributions

B. Boot block, superblock, inode block and data block

C. Understanding inodes

D. Linux Loader & GRUB

E. Linux drives and partition schemes

F. Sleuth Kit, Autopsy, HELIX and KNoppix

UNIT 8: MAC Forensics

A. HFS, HFS+

B. Finder, File Manager

C. Macintosh acquisition methods using MacQuisition

D. Using Black Bag Tools

UNIT9: Computer Forensic Investigation Reporting

A. Reporting guidelines

B. Witness Requirements

UNIT 10: Anti Forensics

A. Traditional methods

1. Overwriting Data and Metadata
2. Cryptography, Steganography, and other Data Hiding Approaches
3. Decrypting EFS with FTK.

B. Non-traditional methods

1. Targeting forensic tool blind spots
2. Targeting forensic tool vulnerabilities
3. Targeting generic tool/lib vulnerabilities

C. Review of current tools & techniques

Course Learning Outcomes (CLOs):

a) Analyze and evaluate the cyber security needs of an organization.

b) Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.

c) Measure the performance and troubleshoot cyber security systems.

d) Implement cyber security solutions and use of cyber security, information assurance, and cyber/computer forensics software/tools.

e) Comprehend and execute risk management processes, risk treatment methods, and key risk and performance indicators

f) Design and develop security architecture for an organization.

g) Design operational and strategic cyber security strategies and policies.

Text Books:

1. "Digital Forensics and Cyber Crime" by Joshua I James and Frank Breitinger
2. "Forensics Computer Investigator, Digital Forensics Analyst, Job Interview Bottom Line Practical Questions and Answers" by M Kumar
3. "Digital Forensic and Cyber Crime" by R K Jha

Reference Books:

1. "National Security and Counterintelligence in the Era of Cyber Espionage (Advances in Digital Crime, Forensics, and Cyber Terrorism)" by Eugenie de Silva.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE44 **Course Name:** Component Based Software Engineering

Course Credit Hour: 3hr **Total Contact Hour:** 32 hr

Course Objective:

- The aim is to gain the knowledge of current component based models in terms of their design, management and implemented issues. This course will provide in depth knowledge of all the component based so0ftware engineering practices.

Course Description:

- The course introduces fundamental concepts in component based software engineering theory and implementation issues. It includes Component-oriented programming, CBSE process and life cycle models, Component-based design and reuse and Component technologies.

Course Contents:

UNIT I- Introduction to CBSE

Component-Based Software Engineering (CBSE), CBSE vs. Object-Oriented Software Engineering, CBSE methodology, domain engineering, component engineering, component vs. object, Component, component technology, software component, specification of software component, measurement and metrics for CBSE, challenge of CBSE, advantages and disadvantages of CBSE.

UNIT II- Component-Oriented Programming

Component-oriented programming, principle of component-oriented programming, object-oriented programming to component-oriented programming, component-oriented programming vs. object-oriented programming.

UNIT III- CBSE Process and Life Cycle Models

CBSE processes, component-based software life cycle, component selection, component adaptability, component certification, component composition.

UNIT IV- Component-Based Design and Reuse

Principles of component design and reuse, design prototyping, design production, design refactoring, design documentation, component-based software reuse, reusable component, component-based reuse metrics.

UNIT V- Component Technologies

Component technologies: Component Object Model (COM), Distributed Component Object Model (DCOM), Common Object Requesting Broker Architecture (CORBA), Enterprise Java Beans (EJB).

Course Learning Outcomes (CLOs):

On completion of the course students will be able to:

- **CLO-1**: Understand and analyze various methods and techniques of CBSE life cycle models.
- **CLO-2**: Design and implement all modules related to Component –Oriented Programming
- **CLO-3**: Get in depth knowledge of all issues related to Component based design and reuse.
- **CLO-4**: Get in depth knowledge of all latest technologies of component technologies like, COM, DCOM, CORBA and EJB.

Text Books:

- George T. Heineman, William T. Councill, Component-Based Software Engineering: Putting the Pieces Together, Addision Wesley
- Andy JuAn Wang, Kai Qian, Component-Oriented Programming, Willey Interscience

Reference Books:

- Clemens Szyperski, Component Software: Beyond Object-Oriented Programming, Addison Wesley.
- Alan W. Brown, Component-Based Software Engineering, Wiley-IEEE Computer Society.
- Sudha Sadasivam, Component-Based Technology, G. Willy.
- Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc.
- N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co. (P) Ltd., New Delhi.

Online links for study & reference materials:

https://nptel.ac.in/courses/106/101/106101061/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	`- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MACO2 **Course Name**: Disaster Management

Course Credit Hour: 2 **Total Contact Hour** : 20 hr

Course Objectives: -Students will be able to:
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in Syllabus

Course Content:

1 Introduction
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

2 Repercussions of Disasters And Hazards:
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

3 Disaster Prone Areas In India
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post Disaster Diseases And Epidemics

4 Disaster Preparedness And Management
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

5 Risk Assessment
Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Assessment. Strategies for Survival.

6 Disaster Mitigation
Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:
1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies”, Deep &Deep publication Pvt. Ltd., New Delhi.

Course Code: SPCL3 **Course Name:** Advanced Algorithm Lab

List of Experiments

1. Write a program to sort a given set of elements using Merge Sort

2. Write a program to implement Floyd Warshall's algorithm.

3. Write a program to implement Kruskal minimum spanning tree algorithm.

4. Write a program to print all the nodes reachable from a given starting node in a digraph using BFS method

5. Write a program to find shortest paths to other vertices using Dijkstra's algorithm., rom a given vertex in a weighted connected graph,

6. Write a program to find a subset of a given set S = {s1,s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.

7. Write a program to perform fast fourier transform

8. Write a program to implement Strassen's matrix multiplication algorithm.

9. Write a program to implement Knapsack algorithm.

10. To Study Np-Complete Theory

Course Code: SPCL4 **Course Name:** Soft Computing Lab

List of Practical

1. Write a program in python to find the simple interest.
2. Write a program in python to find the compound interest.
3. Write a Program in python to check the given year is a leap year or not.
4. Write a program in python to check whether a given number is Fibonacci number or not.
5. Write a program in python to multiply two matrices.
6. Write a program in python to calculate average of numbers.
7. Write a program in python to check reverse number is equals to original number.
8. Write a program in python to check whether a given number is prime or not.
9. Write a program in python to generate a random number.
10. Write a program in python to swap two variables.

Course Code: SPE51 **Course Name:** Mobile Application and Services

Course Credit Hour:3hr **Total Contact Hour:**32hr

Course Objective:

- Learn to setup Android application development environment
- Illustrate user interfaces for interacting with apps and triggering actions
- Interpret tasks used in handling multiple activities
- Identify options to save persistent application data
- Appraise the role of security and performance in Android applications.

Course Description:

- Catalog description: Mobile application development frameworks; Architecture, design and engineering issues, techniques, methodologies for mobile application development. – Additional Notes: Course material includes readings from textbooks, reference books, and research papers and articles.

Course Contents:

Unit-1
Get started, Build your first app, Activities, Testing, debugging and using support libraries

Unit-2
User Interaction, Delightful user experience, Testing your UI

Unit-3
Background Tasks, Triggering, scheduling and optimizing background tasks

Unit-4
All about data, Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders

Unit-5
Permissions, Performance and Security, Firebase and AdMob, Publish

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:** Able to understand to Create, test and debug Android application by setting up Android development environment
- **CLO-2:** Able understand to Implement adaptive, responsive user interfaces that work across a wide range of devices.
- **CLO-3:** Able to analyze performance of android applications and understand the role of permissions and security
- **CLO-4:** Demonstrate methods in storing, sharing and retrieving data in Android applications.

Text books:

- Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developerfundamentals-course-concepts/details (Download pdf file from the above link)

Reference books:

- Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
- Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
- J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
- Anubhav Pradhan, Anil V Deshpande, " Composing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE52 **Course Name:** Compiler for HPC

Course Credit Hour:3hr **Total Contact Hour:**32hr

Course Objective:

- To develop problem solving abilities using HPC
- To develop time and space efficient algorithms.
- To study algorithmic examples in distributed, concurrent and parallel environments.

Course Description:

- This course is using the concepts of compilers and its related topic in context of high performance computing (includes Parallel Processing Concepts, Design Issues in HPC, Synchronization and related algorithms, Advanced tools, techniques and applications).

Course Contents:

Unit-1
Parallel Processing Concepts: Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Organization and Contents of the Text, Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor & Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines Levels of parallelism (instruction, transaction, task, thread, memory, function) Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Comp.

Unit-2
Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architecture examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larra bee Micro architecture and Intel Nehalem micro-architecture Memory hierarchy and transaction specific memory design, Thread Organization.

Unit-3
Fundamental Design Issues in HPC: Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication

Unit-4
Synchronization and related algorithms : Synchronization: Scheduling, Job Allocation, Job Partitioning, Dependency Analysis Mapping Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms Programming Shared Address Space Platforms: Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs, Open MP: a Standard for Directive Based Parallel Programming.

Unit-5
Advanced tools, techniques and applications: Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their limitations, Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Sorting: Issues, Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quicksort, Bucket and Sample Sort, Shared-Address-Space Parallel Formulation, Single -Source Shortest Paths- Distributed Memory Formulation. HPC enabled Advanced technologies : Search Algorithms for Discrete Optimization Problems: Search Overhead Factor, Parallel Depth-First Search, Parallel Best-First Search, Introduction to (Block Diagrams only if any) Peta scale Computing, Optics in Parallel Computing Quantum Computers, Recent developments in Nanotechnology and its impact on HPC Power-aware Processing Techniques in HPC .

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:** Understand the role of HPC in science and engineering.
- **CLO-2:** Be familiar with popular parallel programming paradigms.
- **CLO-3:** Understand commonly used HPC platforms with particular reference to Cluster system.
- **CLO-4:** Understand the means by which to measure, assess and analyse the performance of HPC applications.
- **CLO-5:** Understand the role of administration, workload and resource management in an HPC management software.
- **CLO-6:** Understand the mechanisms for evaluating the suitability of different HPC solutions to solving scientific problems.

Text books:

- Kai Hwang,"Advanced Computer Architecture: Parallelism, Scalability, Programmability", McGraw Hill 1993
- David Culler Jaswinder Pal Singh, "Parallel Computer Architecture: A hardware/Software Approach", Morgan Kaufmann,1999.

Reference books:

- Kai Hwang,, "Scalable Parallel Computing", McGraw Hill 1998
- Peter Pacheco, Introduction to Parallel Programming, Morgan Kaufmann Publishers, 2011;
- Michael J. Quinn, Parallel programming in C with MPI and OpenMP, McGraw-Hill Higher Education, 2004;
- William Gropp, Using MPI: portable parallel programming with the message-passing interface, MIT press, 1999;

Online links for study & reference materials:

https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE53

Course Name: Optimization Techniques

Course Credit Hour:3hr

Total Contact Hour:32hr

Course Objective:

- Learn to Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models. Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex and revised simplex methods, Exceptional cases in LP, Duality theory, Dual Simple method, Sensitivity analysis. Network Analysis: Transportation problem (with transshipment).

Course Description:

- This course deals with optimization techniques (linear and non-linear) used in engineering.Free slack, Total slack, Crashing, Resource allocation. Non-Linear Programming: Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions.

Course Contents:

Unit-1

Introduction to Optimization: Historical Development, Engineering applications of Optimization, Design, vector and constraints, Constraint surface, Objective function, Classification of Optimization Problems

Unit-2

Classical Optimization Techniques: Single variable optimization, Constrained and unconstrained multi-variable, optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions

Unit-3

Linear Programming: Statement of an LP problem, Graphical Solution of an LP problem, Simplex, method, Dual simplex method

Non-linear Programming: One-dimensional minimization method Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, 06 Interval halving method, Fibonacci method, Golden section method, Direct root methods

Unit-4

Non-linear Programming: Unconstrained Optimization Techniques Direct Search Methods: Random search methods, Grid search method, Univariate method, Hookes and Jeeves' method, Powell's method, Indirect Search Methods: Steepest descent method, Fletcher-Reeves method, Newton's method. **Non-linear Programming:** Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming, Indirect methods: Transformation techniques, Exterior penalty function method, Interior penalty function method

Unit-5

Evolutionary Algorithms An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization

Course Learning Outcomes (CLOs):

On successful completion of the course the students will be

- **CLO-1:**Students will be able to understand basic theoretical principles for formulation of optimization models and its solution.
- **CLO-2:**Students will be able to learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques.
- **CLO-3:**Students should be able to apply detailed theoretical and practical aspects of 35% intelligent modelling, optimization and control of linear and non-linear systems

Text books:

- Taha, H.A., Operations Research: An Introduction, Prentice Hall of India (2007) 8th ed. • Kasana, H.S., Introductory Operation Research: Theory and Applications, Springer Verlag (2005).
- Rardin, Ronald L., Optimization in Operations research, Pearson Education (2005). Ravindran A, Phllips D.T. and Solberg J.J. Operation Research: Principles and Practice, John Wiley (2007).

Reference books:

- Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P) Ltd, Publishers
- Kalyanmoy Deb Multi-objective optimization using evolutionary algorithms John Wiley Publicationsposing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2.
- Jasbir S. Arora Introduction to Optimum Design McGraw Hill Publication

Online links for study & reference materials:

1. https://nptel.ac.in/courses/106/102/106102064/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-4	- 05%
Assignment-5	- 05%
Total Internal Assessment	**- 40%**

Course Code: SPE54

Course Name: Object –Oriented Software Engineering

Course Credit Hour: 3hr

Total Contact Hour: 34hr

Course Objective:

- The aim is to gain the knowledge of current object- based models in terms of their design, management and implemented issues. This course will provide in depth knowledge of all the object- based software engineering practices.

Course Description:

- The course introduces fundamental concepts in object- based software engineering theory and implementation issues. It includes Object-oriented programming, OOSE process and life cycle models, COCOMO Model, Requirement Elicitation, Component Inspection, Usability Testing and UML Technologies.

Course Contents:

UNIT -1: Basic Concepts; Project Organization; Communication - Synchronous, Asynchronous; Life Cycle Model - Sequential, Iterative, Entity centered Model; Project Estimation - COCOMO, COCOMO– II, Agile Process.

UNIT -2: Requirement Elicitation - Concepts, Activities, Managing; Analysis - Concept, Activities; Design - Concepts, Activities. Object Design Specifying Interfaces – Interfaces Specification Concepts, Interface Specification Activities.

UNIT -3: Mapping Concepts; Testing – Concepts, Activities – Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, Configuration Management Concepts.

UNIT -4: UML Diagrams – Use Case, Class, Interaction, State Chart, Activity Diagrams. Case Study – Problem Statements & UML Diagrams of Library Management, ATM Management, and Railway Ticket Reservation Systems.

Course Learning Outcomes (CLOs): On completion of the course students will be able to:

- **CLO-1**: Understand and analyze various methods and techniques of OOSE life cycle models.
- **CLO-2**: Understand various requirement elicitation techniques using various methods.
- **CLO-3**: Design various kinds of test cases using various testing techniques like, Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing, and Configuration Management.
- **CLO-4**: Get in depth knowledge regarding UML diagrams using Use Case, Class, Interaction, and State Chart.

Text books :

- Bernd Bruegge, Alan H Dutoit, "Object Oriented Software Engineering" Second Edition, Pearson Education.
- Stephen Schach, "Applying UML and Patterns", Third Edition, Pearson Education.

Reference books :

- Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc.
- N. S. Gill, Software Engineering: Software Reliability, Testing and Quality Assurance, Khanna Book Publishing Co. (P) Ltd., New Delhi

Online links for study & reference materials :

https://nptel.ac.in/courses/106/101/106101061/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment-1	- 05%
Assignment-2	- 05%
Assessment-3(Midexam)	- 20%
Assignment-3	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MOE 0x

Course Name: Waste to Energy

Course Credit Hour: 3

Total Contact Hour: 40hr

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants– Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I &II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley &Sons, 1996.

NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

For

M.Tech

in

Industry and Production Engineering

Program Outcomes (POs)

Students will be able to

1. Ability to apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

2. Ability to identify, formulate and solve engineering problems in the broad areas like Systems Design using communication and networking platforms and tools. Explore recent developments in areas like wireless communication, networking, measurements and standards in communication.

3. Ability to understand and use different software tools for Design, Analysis and Verification in the domain of communication and networking. System results are obtained through progressive steps such as Design entry, Synthesis, Functional and Timing Simulation.

4. Ability to design and conduct experiments, analyse and interpret data, imbibe programming skills for development of simulation experiments.

5. Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
DPCT1	Advanced Communication Networks	3	0	0	40	60	100	3
DPCT2	Wireless and Mobile Communication	3	0	0	40	60	100	3
DPE1x	Program Elective-1 (1) Wireless Sensor Networks (2) Optical Networks (3) Statistical Information Processing	3	0	0	40	60	100	3
SPE2x	Program Elective-2 1. Data Science 2.Distributed Systems 3. Advanced Wireless and Mobile Networks 4. Advanced Software Engineering	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
DPCL1	Advanced Communication Networks Lab	0	0	4	40	60	100	2
DPCL2	Wireless and Mobile Communication Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
SPCT3	Advanced algorithm	3	0	0	40	60	100	3
SPCT4	Soft Computing	3	0	0	40	60	100	3
VPE3x	Program Elective-3 (1) Memory Technologies (2) SoC Design (3) Low power VLSI Design	3	0	0	40	60	100	3
VPE4x	Program Elective-4 (1) Communication Buses and Interfaces (2) Network Security and Cryptography (3) Physical design automation	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
SPCL3	Advanced Algorithm Lab	0	0	4	40	60	100	2
SPCL4	Soft Computing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
DPE5x	Program Elective-5 (1) High Performance Networks (2) Pattern Recognition and Machine Learning (3) Remote Sensing	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4

Paper code	Subject	L	T	P	Marks(ISA)	Marks(ESE)	Total	Credit
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

ADVNACED COMMUNICATION NETWORK

Course Code: DPCT1 **Credit: 03**

Unit 1: Overview of Internet-Concepts, challenges and history, overview of ATM, TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

Unit 2: Real Time Communications over Internet, Adaptive applications, Latency and throughput issues, Integrated Services Model (intServ), Resource reservation in Internet, RSVP, Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

Unit 3: Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service Connections, GPS, WFQ and Rate proportional algorithms, High speed scheduler design, Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic, Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Unit 4: IP address lookup-challenges, Packet classification algorithms and Flow Identification-Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Unit 5: Admission control in Internet, Concept of Effective bandwidth, Measurement based admission control, Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

Unit 6: IPV4, IPV6, IP tunnelling, IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching, MPLS architecture and framework, MPLS Protocols, Traffic engineering issues in MPLS.

References:

- Jean Wairand and Pravin Varaiya, “High Performance Communications Networks”, 2nd edition, 2000.
- Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag, 2001.
- Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
- Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach”, Morgan Kaufman Publishers, 2004.
- George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005.

WIRELESS & MOBILE COMMUNICATION

Course Code: DPCT2 **Credit: 03**

Unit 1: Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Unit 2: Spectral efficiency analysis based on calculations for multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations)

Unit 3: Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit 4: Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Unit 5: Code Division Multiple Access: Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Unit 6: Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

References:

- V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
- V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
- T.S.Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, PHI, 2002.
- William C.Y.Lee, “Mobile Cellular Telecommunications Analog and Digital Systems”, 2nd edition, TMH, 1995.
- Asha Mehrotra, “A GSM system Engineering” Artech House Publishers Boston, London, 1997.

WIRELESS SENSOR NETWORK

Course Code: DPE11 **Credit: 03**

Unit 1: Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Unit 2: Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Unit 3: Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Unit 4: Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

Unit 5: Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Unit 6: Specialized features: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and enabling technologies in wireless sensor network.

References:

- H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
- F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
- YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

OPTICAL NETWORKS

Course Code: DPE12 **Credit: 03**

Unit 1: SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.

Unit 2: WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

Unit 3: Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Unit 4: Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

Unit 5: WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Unit 6: Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

References:

- Rajiv Ramaswami, Sivarajan, Sasaki, “Optical Networks: A Practical Perspective”, MK, Elsevier, 3 rd edition, 2010.
- C. Siva Ram Murthy and Mohan Gurusamy, “WDM Optical Networks: Concepts Design, and Algorithms”, PHI, EEE, 2001.

STATISTICAL INFORMATION PROCESSING

Course Code: DPE13 **Credit: 03**

Unit 1: Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit 2: Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit 3: Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Unit 4: Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Unit 5: Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit 6: Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements, Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

References:

- Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
- Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
- Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

ADVANCED SOFTWARE ENGINEERING SYLLABUS

Subject Code: SPE24 **Credit:3**

UNIT I INTRODUCTION

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design

UNIT IV TESTING

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS

DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Microservices.

REFERENCES:

1.Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2 nd edition, Pearso Education, 2004.

2.Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2 nd edition, PHI Learning Pvt. Ltd., 2010.

ADVANCED COMMUNICATION NETWORKS LAB

Course Code: DPCL1 **Credit: 02**

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
    a. Configuring NIC's IP Address.
    b. Determining IP Address and MAC Address using if-config command.
    c. Changing IP Address using if-config.
    d. Static IP Address and Configuration by Editing.
    e. Determining IP Address using DHCP.
    f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
    a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

WIRELESS AND MOBILE COMMUNICATION LAB

Course Code: DPCL2 **Credit: 02**

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.

2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.

3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.

5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.

6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.

7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.

8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

Advanced Algorithms

Subject Code: SPCT3 **Credit:3**

Unit1

Sorting: Review of various sorting algorithms, topological sorting. Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edgeweighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit 5

Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm

Unit 6

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Soft Computing

Subject Code: SPCT4 **Credits 3**

Unit 1

INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2

FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3

NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Unit 4

GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit 5

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Unit 6

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Elective III

Memory Technologies

Teaching Scheme **Paper Code: VPE31**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Select architecture and design semiconductor memory circuits and subsystems.
- Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
- Knowhow of the state-of-the-art memory chip design

Syllabus Contents:

Unit 1: Random Access Memory Technologies:

Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

Unit 2: DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs.SRAM and DRAM Memory controllers.

Unit 3: Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.

Unit 4: Semiconductor Memory Reliability and Radiation Effects: General Reliability Issues, RAM Failure Modes and Mechanism, Nonvolatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues, Radiation Hardened Memory Characteristics, Radiation Hardness Assurance and Testing.

Unit 5: Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs), Experimental Memory Devices.

Unit 6: Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging

References:

1. Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience
2. Kiyoo Itoh, "VLSI memory chip design", Springer International Edition
3. Ashok K Sharma," Semiconductor Memories: Technology, Testing and Reliability, PHI

Elective III

SoC Design

Teaching Scheme **Paper Code: VPE32**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Identify and formulate a given problem in the framework of SoC based design approaches
- Design SoC based system for engineering applications
- Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

Syllabus Contents:

Unit 1: ASIC

Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.

Unit 2: NISC

NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set, Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.

Unit 3: Simulation

Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.

Unit 4: Low power SoC design / Digital system, Design synergy, Low power system perspective- power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.

Unit 5: Synthesis

Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysisSingle core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs

Unit 6: Case study for overview of cellular phone design with emphasis on area optimization, speed improvement and power minimization.

Note: Students will prepare and present a term paper on relevant identified current topics (in batches of three students per topic) as a part of theory course.

References:

1. Hubert Kaeslin, “Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication”, Cambridge University Press, 2008.
2. B. Al Hashimi, “System on chip-Next generation electronics”, The IET, 2006
3. RochitRajsuman, “System-on- a-chip: Design and test”, Advantest America R & D Center, 2000
4. P Mishra and N Dutt, “Processor Description Languages”, Morgan Kaufmann, 2008
5. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”. Wiley, 2011

Elective III

Low Power VLSI Design

Teaching Scheme **Paper Code: VPE33**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- CO1: Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
- CO2: Characterize and model power consumption & understand the basic analysis methods.
- CO3: Understand leakage sources and reduction techniques.

Syllabus Contents:

Unit 1: Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit 2: Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit 3: Low Power Clock Distribution: Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew vs. tolerable skew, chip & package co-design of clock network.

Unit 4: Logic Synthesis for Low Power estimation techniques: Power minimization techniques, low power arithmetic components- circuit design styles, adders, multipliers.

Unit 5: Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit 6: Low Power Microprocessor Design System: power management support, architectural tradeoffs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

References:

1. P. Rashinkar, Paterson and L. Singh, “Low Power Design Methodologies”, Kluwer Academic, 2002
2. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons Inc.,2000.
3. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
4. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995
5. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

Elective IV

Communication Busses and Interfaces

Teaching Scheme **Paper Code: VPE41**

Lectures: 3 hrs/week

Course Outcomes:

At the end of the course, students will be able to:

- Select a particular serial bus suitable for a particular application.
- Develop APIs for configuration, reading and writing data onto serial bus.
- Design and develop peripherals that can be interfaced to desired serial bus.

Syllabus Contents:

Unit 1: Serial Busses

Physical interface, Data and Control signals, features

Unit 2: limitations and applications of RS232, RS485, I_2C, SPI

Unit 3: CAN - Architecture, Data transmission, Layers, Frame formats, applications

Unit 4: PCIe - Revisions, Configuration space, Hardware protocols, applications

Unit 5: USB - Transfer types, enumeration, Descriptor types and contents, Device driver

Unit 6: Data Streaming Serial Communication Protocol

- Serial Front Panel Data Port (SFPDP) using fibre optic and copper cable

References:

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems ", Lakeview Research, 2_{nd} Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2_{nd} Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 – 200x
6. Technical references on www.can-cia.org, www.pcisig.com, www.usb.org

Elective IV
Network Security and Cryptography

Teaching Scheme **Paper Code: VPE42**
Lectures: 3 hrs/week

Course Outcomes:
At the end of the course, students will be able to:
- Identify and utilize different forms of cryptography techniques.
- Incorporate authentication and security in the network applications.
- Distinguish among different types of threats to the system and handle the same.

Syllabus Contents:
Unit 1: Security
- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

Unit 2: Number Theory
- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

Unit 3: Private-Key (Symmetric) Cryptography
- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

Unit 4: Public-Key (Asymmetric) Cryptography
- RSA, Key Distribution and Management,Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

Unit 5: Authentication
- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

Unit 6: System Security
- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems.

References:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2nd Edition
3. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
4. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2nd Edition

5. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.

Elective IV
Physical Design Automation

Teaching Scheme **Paper Code: VPE43**
Lectures: 3 hrs/week

Course Outcomes:
At the end of the course, students will be able to:
- Study automation process for VLSI System design.
- Understanding of fundamentals for various physical design CAD tools.
- Develop and enhance the existing algorithms and computational techniques for physical design process of VLSI systems.

Syllabus Contents:
Unit 1: Introduction to VLSI Physical Design Automation.
Unit 2: Standard cell, Performance issues in circuit layout, delay models Layout styles.
Unit 3: Discrete methods in global placement.
Unit 4: Timing-driven placement. Global Routing Via Minimization.
Unit 5: Over the Cell Routing - Single layer and two-layer routing, Clock and Power Routing.
Unit 6: Compaction, algorithms, Physical Design Automation of FPGAs.

HIGH PERFORMANCE NETWORKS

Course Code: DPE51 **Credit: 03**

Unit 1: Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture, Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Unit 2: VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks, Providing IP quality of service for voice, signalling protocols for VoIP, PSTN gateways, VoIP applications.

Unit 3: VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Unit 4: Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Unit 5: Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

Unit 6: Infrastructure for network management, internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.

References:

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
- Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
- Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
- Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
- Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
- Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.
- William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

PATTERN RECOGNITION AND MACHINE LEARNING

Course Code: DPE52 **Credit: 03**

Unit 1
Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error Analysis

Unit 2
Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

Unit 3
Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4
Linear discriminant functions - decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5
Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unit 6
Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

References:

- Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.
- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
- C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

REMOTE SENSING

Course Code: DPE53 **Credit: 03**

Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned spacecrafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film -Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT -Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification– Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

- Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6thEdition
- John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
- John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis, 1999.
- Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
- Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
- Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W. H. Freeman & Co, 1978.

Dissertation

Dissertation Phase – I and Phase - II

Teaching Scheme **Paper Code: MTC03 & MTC04**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.