NOIDA INTERNATIONAL UNIVERSITY

SCHOOL OF ENGINEERING & TECHNOLOGY

EVALUATION SCHEME & SYLLABUS

FOR

BACHELOR OF TECHNOLOGY

Mechanical Engineering

(4 Year Course)

W.E.F Session 2018-2019 onwards

Course Curriculum

FOR B.TECH-ME COURSE
(Effective from Academic session 2018-2019)

Introduction- Mechanical engineering is an engineering branch that combines engineering physics and mathematics principles with materials science to design, analyze, manufacture, and maintain mechanical 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 (165 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	15	5.5	20.5
2nd	12	5.5	17.5
3rd	22	0	22
4th	19	6	24
5th	18	2.5	20.5
6th	18	4.5	22.5
7th	12	8	20
8th	12	6	18
Total	110	48	165

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-ME

FIRST SEMESTER

S.No	Course Code	Subject	Period			Evaluation Scheme					
						Internal Assessment			External Assessment	Total	Total Credits
			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	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-I	3	1	0	20	20	40	60	100	4
2	BSC104	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	ESC104P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1
Total											**17.5**

THIRD SEMESTER

COURSE		Contact Hours/Week			Credit	Evaluation Scheme				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
BSC201	Physics-II	3	1	0	4	20	20	40	60	100
BSC202	Mathematics-III	3	1	0	4	20	20	40	60	100
BSC203	Biology	3	0	0	3	20	20	40	60	100
ESC201	Basic Electronics Engineering	3	1	0	4	20	20	40	60	100
ESC202	Engineering Mechanics	3	1	0	1	20	20	40	60	100
PCC ME201	Thermodynamics	3	1	0	3	20	20	40	60	100
Total		**18**	**5**	**0**	**23**					**600**
FOURTH SEMESTER										
PCC-ME202	Applied Thermodynamics	3	1	0	3	20	20	40	60	100
PCC-ME203	Fluid Mechanics and Fluid Machines	3	1	0	3	20	20	40	60	100
PCC-ME204	Strength of Materials	3	1	0	3	20	20	40	60	100
PCC-ME205	Material Engineering	3	0	0	3	20	20	40	60	100
PCC-ME206	Instrumentation and Control	3	1	0	3	20	20	40	60	100
PRACTICALS										
Total		**15**	**4**	**0**	**19**					500

FIFTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PCCME301	Heat Transfer	3	0	0	4	20	20	40	60	100
PCCME302	Solid Mechanics	3	0	0	4	20	20	40	60	100
PCCME303	Manufacturing Process	3	0	0	3	20	20	40	60	100
PCCME304	Kinematics and Theory of Machines	2	0	0	4	20	20	40	60	100
HSMC301	Industrial Psychology	3	0	0	3	20	20	40	60	100
PRACTICALS										
PCCME305	Mechanical Engineering Laboratory(Thermal)	0	0	4	1.5	20	20	40	60	100
PROJ-ME306	Project-I	0	0	4	1	20	20	40	60	100
Total		**17**	**0**	**14**	**20.5**					**700**
SIXTH SEMESTER										
PCCME307	Manufacturing Technology	3	0	0	4	20	20	40	60	100
PCCME308	Design of Machine Elements	3	0	0	4	20	20	40	60	100
	Elective I	3	0	0	3	20	20	40	60	100
	Elective II	3	0	0	3	20	20	40	60	100
OEC302	Open Elective-II	3	0	0	4	20	20	40	60	100
PRACTICALS										
PCCME309	Mechanical Engineering Laboratory (Design) II	0	0	4	1.5	20	20	40	60	100
PROJ-ME-310	Project II	0	0	3	3	20	20	40	60	100
	Total	**15**	**0**	**14**	**21.5**					700

****The marks will be awarded on the basis of industrial training conducted after 5th semester**

SEVENTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
PCC-ME-401	Automation in Manufacturing	3	0	0	3	20	20	40	60	100
	Elective III	3	0	0	3	20	20	40	60	100
	Elective IV	3	0	0	3	20	20	40	60	100
OEC401	Open Elective-III	3	0	0	3	20	20	40	60	100
PRACTICALS										
PCCME402	Mechanical Engineering Laboratory III (Manufacturing)									
PROJ-ME403	Industrial Seminar**	0	0	2	1	20	20	40	60	100
PROJ-ME70	Project-III	0	0	4	4	20	20	40	60	100
Total		**12**	**0**	**6**	**15**					

****The marks will be awarded on the basis of 06 weeks industrial training conducted after 6th semester**

EIGHTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks				
Code	**Course Title**	**L**	**T**	**P**		**CA**	**TA**	**Int. Total**	**Ext.**	**Total**
	Elective V	3	0	0	3	20	20	40	60	100
	Elective VI	3	0	0	3	20	20	40	60	100
OEC402	Open Elective IV	3	0	0	3	20	20	40	60	100
OEC403	Open Elective V	3	0	0	3	20	20	40	60	100
PRACTICALS										
PROJ-ME404	Project IV**	0	0	12	6	100	100	200	300	500
Total		**6**	**0**	**12**	**12**					

**** Project Synopsis Seminar**

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

LIST OF ELECTIVES

Thread 1: Theory		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PCC-MEL321	IC Engine
Elective II	PCC-MEL322	Mechatronics
Elective III	PCC-MEL323	Microprocesser in Automation
Elective IV	PCC-MEL324	Composite Materials
Elective V	PCC-MEL325	Computer Aided Design

Thread 2: Core		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PCC-MEL421	Refrigeration and Air Conditioning
Elective II	PCC-MEL422	Finite Element Analysis
Elective III	PCC-MEL423	Power Plant Engineering
Elective IV	PCC-MEL424	Gas Dynamics & Jet Propulsion
Elective V	PCC-MEL425	Process Planning & Cost Estimation
Additional Subject (can replace with any elective from the same thread):		
Thread 3:Principle & Management		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PCC-MEL431	Principles of Management
Elective II	PCC-MEL432	Automobile Engineering
Elective III	PCC-MEL433	Design of Transmission System
Elective IV	PCC-MEL434	Energy Conservation and Managment
Elective V	PCC-MEL435	Total Quality Managment
Thread 4: Applications		
Elective(s)	**Subject Code**	**Subject Name**
Elective I	PCC-MEL441	Nanotechnology and Surface Engineering
Elective II	PCC-MEL442	Entrepreneurship Development Program
Elective III	PCC-MEL443	Design of Bearing and Shafts
Elective IV	PCC-MEL444	Mechanical System Design
Elective V	PCC-MEL445	Vibration Engineering
Elective VI	PCC-MEL446	Human Resource Management
Elective VII	PCC-MEL447	Design of Thermal System

SEMESTER-I

DETAILED CURRICULUM CONTENTS

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.
- **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: 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 EXPERIMENTS

FIRST SEMESTER

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**.**
8.

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: 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-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: 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: 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 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:

Unit-I

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

Unit-II

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.

Unit-III

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.

Unit-IV

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:

Unit-I

Deformation in solids-: Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains

Unit-II

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

Unit-III

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.

Unit-IV

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 ME301 **Course Name:** Heat Transfer
Course Credit: 4 **Total Contact Hour:** 40hr

Course Objective:

- The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.
- To formulate the models necessary to study, analyze and design heat transfer systems through the application of these principles.

Course Description:

Heat transfer is important across a wide range of engineering problems, and this course is sufficiently broad and self-contained to be suitable for students in all engineering curricula; it is required for mechanical engineering students. The materials are chosen to provide the student with both a quantitative and an intuitive capability for dealing with heat transfer problems. Examples range from solar collectors and nuclear reactors to microwave cooking and beer can cooling. In addition to analytical solutions, the student is familiarized with the use of finite element methods for numerical solution of thermal problems. Lectures and discussion stress the close relationships between thermal modeling and design decisions. Heat Transfer uses calculus and differential equations, which are prerequisites, and taking a basic fluids course prior to Heat Transfer is highly recommended. Heat Transfer is most frequently taken during the junior year.

Course Contents:

Unit-I

One Dimensional Steady State Heat Conduction: Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry.Heat transfer through pin fins

Unit-II

Multi Dimensional Steady and Unsteady State Heat Conduction: concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.

Unit-III

Convection: Heat convection,basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Unit-IV

Radiation: Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

Unit-V

Heat Exchanger and Mass Transfer: Types of heat exchangers, Analysis and design of heat exchangers using bothLMTD and εNTU methods.(6) Boiling and Condensation heat transfer, Pool boiling curve (3) Introduction mass transfer, Similarity between heat and mass transfer (3) Total number of hours.

Course Learning Outcomes(CLOs) :

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

- Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
- Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
- Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Text books:

- A. Bejan, Heat Transfer John Wiley, 1993.
- J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.A. .

Reference books:

- F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition,

  2007.

- Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002

- Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002 .

Online links for study & reference materials:

http://nptel.ac.in/course/112/108/112108149

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: 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%**

LAB EXPERIMENT

FIFTH SEMESTER

Course Code: PCC-ME305 **Course Name:** Mechanical Engineering Laboratory (Thermal)

Course Credit: 1.5 **Total Contact Hour:** 20hr

Course Objective:

(i) To understand the principles and performance characteristics of flow and thermal devices
(ii) To know about the measurement of the fluid properties

Course Description:

This course is a lab course in which students will perform various experiments of Thermal engineering. This course intends to give the practical knowledge of the theoretical learning of mainly fluid mechanics, internal combustion engines, heat and mass transfer and fluid machinery. Students will be confident enough in the field work after successful completion of this course.

Course Contents:

1. Measurement of Coefficient of Discharge of given Orifice and Venturi meters
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine
7. Determination of the thermal conductivity and specific heat of given objects
8. Determination of the calorific value of a given fuel and its flash & fire points
9. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
10. Determination of the convective heat transfer coefficient for flow over a heated Plate
11. Determination of the emissivity of a given sample
12. Determination of the performance characteristics of a vapour compression system

Course Learning Outcomes(CLOs) :

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery

Text/ Reference 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.
3. Heat and Mass Transfer, Cengel Y.A. and Ghajjar M. A., 2005, McGraw-Hill Education.
4. Internal Combustion Engine, Ganesan V.,2007, McGraw-Hill Education

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%**

SEMESTER-VI

DETAILED CURRICULUM CONTENTS

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: PCC-ME308 **Course Name:** Design of Machine Elements

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

Course Objective:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components

2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations

3. An overview of codes, standards and design guidelines for different elements

4. An appreciation of parameter optimization and design iteration

5. An appreciation of the relationships between component level design and overall machine system design and performance

Course Description:

This course is an introduction to the design of various machine elements commonly used in mechanical engineering applications. The basic knowledge of engineering mechanics and strength of materials is used along with the various theories of failure to design and analyze the various machine elements. The course addresses the designing of various machine elements like various types of shafts, bearings, joints, springs, gears and couplings.

Course Contents:

UNIT 1:

Introduction: Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure).

UNIT 2:

Shafts and Bearings: Design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings.

UNIT 3:

Transmission elements: Design of spur, helical, bevel and worm gears; belt and chain drives, Design of springs: helical compression, tension, torsional and leaf springs.

UNIT 4:

Joints: Design of threaded fasteners, pre-loaded bolts and welded joints.

UNIT 5:

Power Screws, Clutches and Brakes: Analysis and applications of power screws and couplings, Analysis of clutches and brakes.

Course Learning Outcomes(CLOs) :

1. After completing this course students will get an overview of the design methodologies employed for the design of various machine components.
2. Students will be able to design and analyze the various machine elements used in mechanical engineering applications

Text books:

[1] Bhandari V.B. , Design of Machine Elements, Third Edition, McGraw-Hill Education, 2010.

[2] Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

Reference books:

[1] Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

[2] Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.

[3] Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994. [5] R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.

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%**

Lab Code: PCC-ME 309 **Lab Name:** Mechanical Engineering Laboratory (Design) II

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

Objectives:

(i) To understand the measurement of mechanical properties of materials
(ii) To understand the deformation behaviour of materials
(iii) To understand the kinematic and dynamic characteristics of mechanical devices

List of Experiments:

1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Microscopic examination of heat-treated and untreated metallic samples
7. Velocity ratios of simple, compound, epicyclic and differential gear trains
8. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms.
9. Cam & follower and motion studies
10. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient
11. Determination of torsional natural frequency of single and double rotor systems un damped and damped natural frequencies

Course Outcomes:

Students who have undergone the course will be able to understand the measurement of mechanical properties of materials and will be able to characterize the dynamic behaviour of mechanical systems

SEMESTER-VII

DETAILED CURRICULUM CONTENTS

Course code: PCC-ME401 **Course name:** Automation in Manufacturing
Course credits: 3 credits **Total contact hours:** 40 hrs

Course Objectives:

- To understand the importance of automation in the of field machine tool-based manufacturing.
- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
- To understand the basics of product design and the role of manufacturing automation.

Course description:

This course describes the principles of NC, CNC, DNC. It gives the basic introduction to automation, industrial control systems. It introduces the concept of industrial robotics with automation which are developed using different actuators, sensors and other control system component. This course in addition to automation gives insight view of technologies used in transportation and material handling equipment.

Course Contents:

Unit 1

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools.

Unit-2

Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Unit-3

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods;

Unit-4

Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNCAdaptive Control Low-cost automation: Mechanical & Electromechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies.

Unit-5

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

Course Learning Outcomes (CLOs):

Upon completion of this course, the students will

- Get a comprehensive picture of computer-based automation of manufacturing operations.
- Understand modelling, simulation and optimization.

Text Books:

- Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall
- SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition, Pearson ,

Reference Books:

- YoramKoren, Computer control of manufacturing system, 1st edition
- Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

Online links for study and reference materials:

https://nptel.ac.in/courses/112/103/112103293/

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 EXPERIMENTS
SEVENTH SEMESTER

Lab Code: PCC-ME 402 **Lab Name:** Mechanical Engineering Laboratory (Manufacturing) III

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

Objectives:

1. To provide an understanding of advanced manufacturing methods.
2. To get an idea of the dimensional & form accuracy of products

List of Experiments: (About 12 experiments will be carried out as listed below)

.

1. Taper turning and external thread cutting using lathe
2. Contour milling using vertical milling machine
3. Spur gear cutting in milling machine
4. Measurement of cutting forces in Milling/ Turning process
5. CNC part programming
6. Drilling of a small hole using wire EDM
7. Microprocessor controlled pick & place robot
8. Use of Tool Maker's Microscope
9. Comparator and sine bar
10. Surface finish measurement equipment
11. Bore diameter measurement using micrometer and telescopic gauge

Course Outcomes:

Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced

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 Hours:** 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	**40%**

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

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

: 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

- 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: PCC-MEL443 **Course Name:** Design of Bearings and shafts

Course Credit: 3 **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	**40%**

Course Code: PCC-MEL447 **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 thermo fluid 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:

http://nptel.ac.in/course/112/108/112108149

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%**