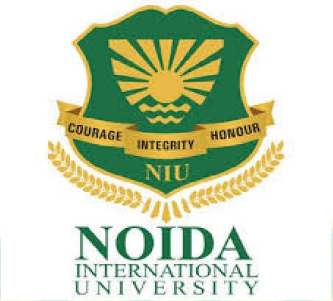
Noida International University



Evaluation Scheme & Syllabus

For

B. Tech

(Bio Technology)

On

AICTE MODEL CURRICULUM

(Effective from the Session: 2018-19)

Noida International University

FOR B. TECH-BIOTECHNOLOGY COURSE

(Effective from Academic session 2018-2019)

Introduction- B. Tech in Biotechnology is an academic programme of the duration of four years. Biotechnology engineering is an undergraduate degree programme in applied sciences that amalgamates the facts from both Biological sciences and technology. This study utilizes the biological processes which include the study of microorganisms or knowledge of antibiotics and further implement them in various industrial purpose.

In simple terms, Biotechnology is a study which involves the use of living organisms. The living organisms are used to make useful chemicals which can be utilized in industries. Biotechnological products are used in areas like agriculture, food sciences and medicine.

Program Educational Objectives (PEOs)

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

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

Programme specific outcome (PSO)

- Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences.
- Acquire knowledge in domain of biotechnology enabling their applications in industry and research.
- Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology
- Recognize the importance of Bioethics, IPR, entrepreneurship, Communication and management skills so as to usher next generation of Indian industrialists.
- Understand the applications of biotechnology in all spheres of agriculture and develop crops with improved productivity thereby increasing farmers' income, better human health and decreased environmental pollution.

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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

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

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

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

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

S.no.	Credit Breakups	Credits
1	Humanities and Social Sciences including Management courses	11
2	Basic Science courses	23
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	20
4	Professional core courses	59
5	Professional Elective courses relevant to chosen specialization/branch	16
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	17
8	Mandatory Courses	0
		*158

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

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

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

Credit distribution in each semester (160 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	14	6.5	20.5
2nd	13	4.5	17.5
3rd	18	4	22
4th	18	3	21
5th	18	3	21
6th	15	5	20
7th	14	7	21

8th	6	9	15
Total	**116**	**42**	**158**

Course coding system

Every course coded as follows:

BSC : Basic Science Courses

ESC : Engineering Science Course

MC : Mandatory Courses

HSMC : Humanities and Social Sciences including Management

PCC : Program core courses

PEC : Program Elective courses

OEC : Open Elective courses

SEMESTER I											
S.No	**Course Code**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	BSC 101	Mathematics –I	3	1	0	20	20	40	60	100	4
2	BSC104	Chemistry-I	3	1	0	20	20	40	60	100	4
3	HSMC 101	English	2	0	0	20	20	40	60	100	2
4	ESC101	Programming for Problem Solving	3	0	0	20	20	40	60	100	3
5	ESC103	Engineering Graphics	1	0	0	20	20	40	60	100	1
		Induction Program	-	-	-	-	-	-	-		0
PRACTICALS											
1	BSC 104P	Chemistry-I Lab	0	0	3	-	-	40	60	100	1.5
2	ESC101P	Programming for Problem Solving Lab	0	0	4	-	-	40	60	100	2
3	ESC103P	Engineering graphics Lab	0	0	4			40	60	100	2
4	HSMC101P	English Lab	0	0	2			40	60	100	1
Total											**20.5**

SEMESTER II											
Sl. No	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total**	**External**	**Total**	**Credits**
1	BSC102	Physics	3	1	0	20	20	40	60	100	4
2	BSC 103	Mathematics –II	3	1	0	20	20	40	60	100	4
3	ESC102	Workshop/Manufacturing Practices	1	0	0	20	20	40	60	100	1
4	ESC104	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
5	AECC01	Environmental Studies	2	0	0	20	20	40	60	100	0
PRACTICALS											
1	BSC101P	Physics Lab	0	0	3	-	-	40	60	100	1.5
2	ESC102P	Workshop/Manufacturing Practices	0	0	4	-	-	40	60	100	2
3	ESC104P	Basic Electrical Engineering Lab	0	0	2	-	-	40	60	100	1
Total											**17.5**

SEMESTER- III											
Sl. No	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	ESC 201	Data Structure & Algorithms	3	1	0	20	20	40	60	100	4
2	HSMC 201/ HSMC 202	Effective Technical Communication/Universal Human values	2 3	1 0	0 0	20	20	40	60	100	3
3	PCC-BT 301	Techniques in Biotechnology	3	1	0	20	20	40	60	100	4
4	PCC-BT-302	Microbiology & Immunology	3	1	0	20	20	40	60	100	4
5	PCC-BT-303	Biochemistry	3	0	0	20	20	40	60	100	3
6	PLC-BT-321	Techniques in Biotechnology Lab	0	0	2	20	20	40	60	100	1
7	PLC-BT-322	Microbiology & Immunology Lab	0	0	2	20	20	40	60	100	1
8	PLC-BT-323	Biochemistry Lab	0	0	2	20	20	40	60	100	1
9	PROJ- BT-01	Mini Project or Internship Assessment*	0	0	2	20	20	40	60	100	1
10		**MOOCs (Essential for Hons Degree)**									
		Total	**19**		**8**					**1000**	**22**

***The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.**

SEMESTER- IV											
Sl. No.	**Subject Codes**	**Subjects**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	BSC 202	Maths V	3	1	0	20	20	40	60	100	4
2	HSMC 202/ HSMC 201	Universal Human Values/ Effective Technical Communication	3 / 2	0 / 1	0 / 0	20	20	40	60	100	3
3	PCC-BT 401	Bioprocess Engineering I	3	0	0	20	20	40	60	100	3
4	PCC-BT 402	Genetics & Molecular Biology	3	1	0	20	20	40	60	100	4
5	PCC-BT 403	Enzyme Engineering	3	1	0	20	20	40	60	100	4
6	PLC-BT 401	Bioprocess Engineering I Lab	0	0	2	20	20	40	60	100	1
7	PLC-BT 402	Genetics & Molecular Biology Lab	0	0	2	20	20	40	60	100	1
8	PLC-BT 403	Enzyme Engineering Lab	0	0	2	20	20	40	60	100	1
9	MC 401	Python	2	0	0	20	20	40	60	100	0
10		**MOOCs (Essential for Hons Degree)**									
		Total								**900**	**21**

SEMESTER- V											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credits**
1	PCCBT 501	Genetic Engineering	3	1	0	20	20	40	60	100	4
2	PCCBT 502	Fermentation Biotechnology	3	1	0	20	20	40	60	100	4
3	PCCBT 503	Bioinformatics I	3	1	0	20	20	40	60	100	4
4	DEBT 1X	Departmental Elective-I	3	0	0	20	20	40	60	100	3
5	DEBT 2X	Departmental Elective-II	3	0	0	20	20	40	60	100	3
6	PLCBT 551	Genetic Engineering lab	0	0	2	20	20	40	60	100	1
7	PLCBT 552	Fermentation Technology Lab	0	0	2	20	20	40	60	100	1
8	PLCBT 553	Bioinformatics- I virtual lab	0	0	2	20	20	40	60	100	1
9	MC 501	Constitution of India	0	0	0	20	20	40	60	100	0
10	PROJ- BT-02	Mini Project or Internship Assessment*	0	0	2	20	20	40	60	100	2
11		**MOOCs (Essential for Hons. Degree)**									
		Total	**15**	**3**	**8**					**1000**	**23**

***The Mini Project or internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.**

SEMESTER-VI											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	PCC BT-601	Bioprocess Engineering - II	3	1	0	20	20	40	60	100	3
2	PCC BT-602	Plant Biotechnology	3	1	0	20	20	40	60	100	3
3	PCC BT-603	Bioinformatics -II	3	1	0	20	20	40	60	100	3
4	DE BT 3X	Departmental Elective-III	3	0	0	20	20	40	60	100	3
5	OE BT X	Open Elective-I	3	0	0	20	20	40	60	100	3
6	PLC BT-651	Bioprocess Engineering – II Lab	0	0	2	20	20	40	60	100	1
7	PLC BT-652	Plant Biotechnology Lab	0	0	2	20	20	40	60	100	1
8	PLC BT-653	Bioinformatics-II Lab	0	0	2	20	20	40	60	100	1
10		**MOOCs (Essential for Hons. Degree)**									
		Total								**800**	**18**

SEMESTER-VII											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	HSMC 401	Intellectual Property Rights (IPR) & Regulatory	1	1	0	20	20	40	60	100	2
2	PCC BT-701	Professional Core Course	2	0	0	20	20	40	60	100	3
3	DE BT 4X	Departmental Elective IV	3	0	0	20	20	40	60	100	3
3	DE BT 4X	Departmental Elective V	3	0	0	20	20	40	60	100	3
4	OE BT X	Open Elective II	3	0	0	20	20	40	60	100	3
5	PLC BT-751	Professional Core Course Lab	0	0	2	20	20	40	60	100	1
6	DLE BT-752	Departmental Elective IV Lab	0	0	2	20	20	40	60	100	1
7	PS 401	Project I	0	0	10	-	-	200	100	300	5
8		**MOOCs (Essential for Hons. Degree)**									
		Total								**1000**	**21**

SEMESTER-VIII											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	OE BT X	Open Elective III	2	1	0	20	20	40	60	100	3
2	OE BT X	Open Elective IV	3	0	0	20	20	40	60	100	3
3	PS 402	Project II	0	0	18	-	-	300	300	600	9
4		**MOOCs (Essential for Hons. Degree)**									
		Total								**800**	**15**

B. TECH BIOTECHNOLOGY
(LIST OF PROFESSIONAL ELECTIVES & OPEN ELECTIVES SUBJECTS)

DEPARTMENTAL ELECTIVES -I
DE BT 11: Pharmaceutical Biotechnology
DE BT 12: Nano Biotechnology
DE BT 13: Biomedical Instrumentation
DE BT 14: Metabolic Engineering

DEPARTMENTAL ELECTIVES - II
DE BT 21: Biofuels and alcohol technology
DE BT 22: Descriptive Statistics & Process Control
DE BT 23: 3-D Printing
DE BT 24: Molecular modelling and drug design

DEPARTMENTAL ELECTIVES – III
DE BT 31: Animal Biotechnology
DE BT 32: Biomarker & Diagnostics
DE BT 33: Food Biotechnology
DE BT 34: Entrepreneurship in Biotechnology

DEPARTMENTAL ELECTIVES – IV
DE BT 41: Big Data Analytics
DE BT 42: Biosimilar Technology
DE BT 43: Stem Cell Technology
DE BT 44: Gene Expression & Transgenic

DEPARTMENTAL ELECTIVES – V
DE BT 51: Precision Medicine & Wellness
DE BT 52: Tissue Engineering
DE BT 53: Waste Management & Upcycling

OPEN ELECTIVES-I
1. Database Management System
2. Embedded System
3. GIS & Remote Sensing
4. Computer based Numerical Techniques

OPEN ELECTIVES-II
1. Internet of Things
2. Artificial Intelligence
3. Software Project Management System

OPEN ELECTIVES-III
1. Robotics
2. Food and Nutrition Technology
3. Cyber Security

OPEN ELECTIVES-IV
1. Bioterrorism and National Security
2. Data Sciences
3. Block chain

SEMESTER-I

DETAILED CURRICULUM CONTENTS

Course Code: BSC101 **Course Name:** Mathematics-I
Course Credit: 4 **Total Contact Hour:** 40hrs

Course Objective:

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

Course Description:

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

Course Contents:

UNIT-I: Calculus: (6 lectures)
Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

UNIT-II: Calculus: (6 lectures)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

UNIT-III: Sequences and series: (10 lectures)
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT-IV: Multivariable Calculus (Differentiation): (8 lectures)
Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

UNIT-V: Matrices (10 lectures)
Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Course Learning Outcomes (CLOs):

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

Text books:

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

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Online links for study & reference materials:

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

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

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

Course Code: BSC102 **Course Name:** Chemistry-I
Course Credit Hour: 4hr **Total Contact Hour:** 45hr

Course Objective:

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

Course Description:

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

Course Contents:

UNIT-I: Atomic and molecular structure

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

UNIT-II: Spectroscopic techniques and applications

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

UNIT-III: Intermolecular forces and potential energy surfaces

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

UNIT-IV: Use of free energy in chemical equilibria

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

metallurgy through Ellingham diagrams.

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

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

UNIT-VII: Organic reactions and synthesis of a drug molecule
Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Learning Outcomes (CLOs):
The course will enable the student to:

- **CLO-1**: Students will learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.
- **CLO-2**: Student will achieve advanced knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy.
- **CLO-3**: Student can explain how intermolecular forces determine physical properties of molecules; especially boiling point, melting point and viscosity.
- **CLO-4**: Student can answer why chemical reactions occur? the driving force(s) that are responsible for physical and chemical changes.
- **CLO-5**: Student can apply the knowledge of periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity while planning use of any material for industrial purpose.
- **CLO-6**: Distinguish between different kinds of isomers, cis/trans or E/Z, superimposable, chiral/achiral, define enantiomers, levorotatory or dextrorotatory, racemic mixture, Distinguish between enantiomers and diastereomer, Understand the relationship between biological properties of pairs of enantiomers or diastereomer
- **CLO-7**: Student can list major chemical reactions that are used in the synthesis of molecules.

Text books:

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

Reference books:

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

Online links for study & reference materials:
https://nptel.ac.in/courses/104/103/104103071/

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

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

Course Code: HSMC101 **Course Name:** English
Course Credit Hour: 2 Hr **Total Contact Hours:** 20hr

Course Objective:

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

Course Description:

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

Course Contents:

UNIT-I: Vocabulary Building (4 lectures)

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

UNIT-II: Basic Writing Skills (4lectures)

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

UNIT-III: Identifying Common Errors in Writing (4 lectures)

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

UNIT-IV: Nature and Style of sensible Writing (4 lectures)
Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion Writing Practices Comprehension Précis Writing Essay Writing

UNIT-V: Oral Communication **(4 lectures)**
(This unit involves interactive interaction)

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

Course Learning Outcomes (CLOs):

- CLO-1: Develop the vocabulary building and basic grammar concepts.
- CLO-2: Inculcate speaking skills and listening skills.
- CLO-3: Develop the writing skills.

- CLO-4: Understand technical writing skills.
- CLO-5: Demonstrate all skills in presentation and interviews.

Text books:

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

Reference books:

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

Online links for study & reference materials:

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

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

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

Course Code: ECS101 **Course Name:** Programming for Problem Solving
Course Credit Hour: 4hr **Total Contact Hour:** 42hr

Course Objective:

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

Course Description:

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

Course Contents:

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

UNIT-II: Arithmetic expressions and precedence
Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

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

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

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

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

UNIT-VII: Structure
Structures, Defining structures and Array of Structures.

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

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

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

- **CLO-1**: Formulate simple algorithms for arithmetic and logical problems.

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

Text books:

(i) Byron Gottfried, Schaum's Outline of Programming with C, Third Edition, McGraw-Hill.
(ii) E.Balaguruswamy, Programming in ANSI, Tata McGraw- Hill.
(iii) Yashavant Kanetkar, Let Us C, BPB Publications.

Reference books:

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

Online links for study & reference materials:
https://nptel.ac.in/courses/106/104/106104128/

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

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

LAB EXPERIMENTS
FIRST SEMESTER

Lab Code: ESC101P
Course Credit: 2

Lab Name: Programming for Problem Solving
Total Contact Hour: 04

List of Experiments:

Problems based on if-then-else structure:

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

Problems based on while loop and for loop:

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

R=1 c=1 sum=2
R=1 c=2 sum=3
R=2 c=1 sum =3
R=2 c=2 sum=4

6. Write a program to print the following pattern

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

7. Write a program to print the square and cube of any given number**.**

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

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

Problems based on Structures:

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

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

1. Write function which receives a float and an integer from main (), find the product of these two and returns the product which is printed through main ().
2. Write a function that receives marks received by a student in 3 subjects and returns the average and percentage of these marks. Call this function from main and print the result in main.
3. Find the smallest number in an array.

4. Any year is entered through the keyboard. Write a function to determine whether the year is a leap year or not.
5. Write a function that receives 5 integers and returns the sum, average of these numbers. Call this function from main () and print the result in main ().
6. Write a program to add two numbers using pointers**.**
7. Write a program to store n elements in an array and print all elements using pointer.
8. Write a program to read array elements and print array addresses using pointer.
9. Write a program to compute the sum of all elements in an array using pointer.
10. Write a program to print the elements of an array in reverse order using pointer.

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

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

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

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

List of Experiments:

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

SEMESTER-II

DETAILED CURRICULUM CONTENTS

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

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

Course Objective:

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

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

Course Description:

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

Course Contents:

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

Introduction to Quantum mechanics
Wave nature of particles
Time independent and time dependent Schrodinger equation for wave function
Born interpretation
Probability current
Expectation values
Free particle wavefunction and wave packets
Uncertainty principle

UNIT-II: Mathematical Preliminaries for Quantum Mechanics (4 Lectures)

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

UNIT-III: Applying the Schrodinger equation (15 Lectures)

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

UNIT-IV: Introduction to Molecular Bonding (4 Lectures)

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

UNIT- V: Introduction to Solids (7 Lectures)

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

Course Learning Outcomes (CLOs):

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

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

Text Books

- Eisberg and Resnik, Introduction to Quantum Physics

Reference Books

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

Online links for study & reference materials:

https://nptel.ac.in/courses/122/106/122106034/

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

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

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

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

Course Objective:

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

Course Description:

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

Course Contents:

UNIT I: Multivariable Calculus (Integration): (10 lectures)

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

UNIT II: First order ordinary differential equations: (6 lectures)

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

UNIT III: Ordinary differential equations of higher orders: (8 lectures)

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

UNIT IV: Complex Variable – Differentiation: (8 lectures)

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

UNIT V: Complex Variable – Integration: (8 lectures)

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

Course Learning Outcomes (CLOs):

- CLO-1: Evaluation of areas and volumes, Center of mass and Gravity.
- CLO-2: Solution of first order ordinary differential equations by various methods.
- CLO-3: Solution of ordinary differential equations of higher orders.
- CLO-4: Differentiation of Vector calculus.

- CLO-5: Integration of Vector Calculus.

Text books:

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

Reference books:

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

Online links for study & reference materials:

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

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

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

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

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

Course Objective:

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

Course Description:

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

Course Contents:

UNIT I:

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

UNIT II:

Sheet metal Shop: To make a sheet metal component with galvanized iron sheet as per the drawing provided in the manual having spot welding joint. Any one of the following jobs Jobs: Square tray, Scoop, Funnel.

Fitting Shop To make a joint using fitting tools with mild steel flats, round bars or square bars as per the drawing provided in the manual.

UNIT III:

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

UNIT IV:

Welding Shop- Arc Welding To prepare a welding joint with mild steel flat using Manual Metal Arc welding machine according to the drawing provided in the manual.

Any one of the following jobs Jobs: Lap joint, Butt joint, Fillet/Corner joint.

Gas & Spot Welding To observe the demonstration of making a Lap joint/Butt joint with mild steel sheet using oxyacetylene flame as per the drawing provided in the manual. To perform the spot welding operation on G.I. Sheet.

UNIT V:

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

Course Learning Outcomes (CLOs):

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

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

Text books:

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

Reference books:

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

Online links for study & reference materials:

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

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

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

Course Code: ESC104 **Course Name:** Basic Electrical Engineering
Course Credit: 5 **Total Contact Hour:** 42hr

Course Objective:

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

Course Description:

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

Course Contents:

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

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

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

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

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

UNIT VI: Electrical Installations (6 hours)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Learning Outcomes (CLOs):

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

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

Installations.

Text books:

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

Reference books:

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

Online links for study & reference materials:

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

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

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

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

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

Course Objective:

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

Course Description:

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

Course Contents:

UNIT I: Introduction to Environmental Studies

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

UNIT II: Ecosystem

- Definition and concept of Ecosystem
  Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem
  Physical (energy flow), Biological (food chains, food web, ecological succession) and
  Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological
  pyramids and homeostasis
- Types of Ecosystem – Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries) – their importance and threats on them with relevant examples from India Ecosystem services (Provisioning, Regulating, Cultural and Supporting). Basics of Ecosystem restoration

UNIT III: Natural Resources

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

UNIT IV: Biodiversity and Conservation

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
- India as a mega-biodiversity nation; Endemic and endangered species of India; IUCN Red list; biodiversity hotspots

- Value of biodiversity: Ecological, economic, social, ethical, aesthetic and informational value of biodiversity with examples; sacred groves and their importance with example
- Current mass extinction crisis; Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasion with emphasis to Indian biodiversity
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; Biosphere reserves; Keystone and Flagship species; Species reintroduction and translocation

UNIT V: Environmental pollution

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

UNIT VI: Global Environmental Issues and Policies

- Climate change, Global warming, Ozone layer depletion, Acid rain and impacts on human communities and agriculture
- International agreements: Earth Summit, UNFCCC, Montreal and Kyoto protocols and Convention on Biological Diversity (CBD)
- Sustainable Development Goals and India's National Action Plan on ClimateChange Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980, Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006

UNIT VII: Human Communities and the Environment

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

Field work/ Practicals

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

Course Learning Outcomes (CLOs):

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

- CLO-1 Gain in-depth knowledge on natural processes that sustain life, and govern economy.
- CLO-2: Predict the consequences of human actions on the web of life, global economyand quality of human life.
- CLO-3: Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.
- CLO-4: Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participating actively in solving current environmental problems and preventing the future ones.
- CLO-5: Adopt sustainability as a practice in life, society and industry.

Text books:

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

Reference books:

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

Online links for study & reference materials:

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

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

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

LAB EXPERIMENTS
SECOND SEMESTER

Lab Code: BSC101P **Lab Name:** Physics Lab
Course Credit Hour: 1.5hr **Total Contact Hour:** 03

List of Experiments:

1. Four Probe Setup
2. Stefan`s Law
3. Diode Valve Characteristics
4. Frequency of A.C Mains
5. Band Gap in a Semi-Conductor Diode
6. P-N Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor Common-Base Configuration
9. Transistor Common-Emitter Configuration

Lab Code: ESC102P
Course Credit Hour: 2hr

Lab Name: Workshop/Manufacturing Practice
Total Contact Hour: 04

List of Experiments:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical &Electronics
5. Carpentry
6. Plastic molding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

Lab Code: ESC104P
Course Credit Hour: 1hr

Lab Name: Electrical Engineering Lab
Total Contact Hour: 02

List of Experiments:

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

SEMESTER III

Course Code: ECS 201 **Course Name**: Data Structure & Algorithms

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

Course Objective:

To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.

Course Description:

This course will describe common applications for arrays, records, linked structures, stacks, queues, trees and graphs.

Course Contents:

UNIT-I:
Introduction to data structure and Algorithms: Performance analysis of Algorithm, time complexity, Big-oh notation, Elementary data organization data structure operations, Recurrences, Arrays, Operation on arrays, representation of arrays in memory, single dimensional and multidimensional arrays, spare matrices, Character storing in C, String operations.

UNIT-II:
Stacks, Quesues and Linked Lists: Stack operation, PUSH and POP, Array representation of stacks, Operation associated with stacks Application of stacks, Recursion, Polish experession, Representation quesuesopration on quesues, Priority quesuesDquesues, Singly and circularly linked list, List operations Lists implementations.

UNIT-III:
Tree: Basic terminology, Binary Trees, Binary tree representation, Algebraic/expressions, Complete Binary Trees, Extended binary tree, representing binary tress in memory, linked representation of Binary trees, Traversing binary trees & Searching in binary trees, Inserting in binary search trees, Complexity of searching algorithm, Heaps, general trees, Threaded binary tree.

UNIT-IV:
GraphS: Terminology & representations, Graphs &Multigraphs, Directed Graphs, Sequential representation of graphs, adjacency Matrices, Transversal, connected component and spanning trees, Minimum Cost spanning tree, Prims and Kruskal Algorithm, BFS, DFS, Shortest path and transitive closure, Activity networks, topological sort and critical paths.

UNIT-V:
Searching and Sorting: Linear search, binary Search, Internal and External sorting, Bubble sorting, selection sort, Insertion sort, quick sort, Two way merge sort, Heap sort, sorting on different keys, practical consideration for internal sorting, External Sorting, Storage Devices: Magnetic tapes, Disk Storage, Sorting with disks and Indexing techniques, introduction to B tree and B+ tree, File organization and storage management, Introduction to hoisting.

Course Learning Outcomes (CLOs):

CO1: Designs and analyzes simple algorithms

CO2: Understands and restates the fundamentals of basic data structures.

CO3: Develops skills in implementations and applications of data structures.

Text books:

1. Data Structures and Algorithms, A.V. Aho, J.E. Hopcroft and J. Ullman, Addison- Wesley Publishing
2. Database Design, Development and Deployment with Student CD, P. Rob and E. Semaan, McGraw-Hill/Irwin
3. Schaum‟s Outline of Data Structures with C++, J.R. Hubbard, McGraw Hill Trade.

Reference books:

1. Database system concepts, A. Silberschatz, P.B. Galvin and G. Gagne, John Wiley and Sons Inc.
2. Introduction to Data Structures and Application, J. Tremblay and P.G. Sorensen, McGraw Hill College Division

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

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

Course Code: HSMC 201 **Course Name:** Effective Technical Communication
Course Credit Hour: 3Hr **Total Contact Hour:** 30hr

Course Objective:

The course aims to provide insights related to communication skills. It aims to train the student to the basic concept of effective communication and self-development preparation.

Course Description:

This course introduces the fundamental concepts of communication skills, writing skills presentation skills and technical skills. Topic includes introduction to Grammar, speaking skills, Writing Skills, Presentation skills, Interview skills. Goal settings

Course Contents:

UNIT-I: Information Design and Development-
Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

UNIT-II: Technical Writing, Grammar and Editing-
Technical writing process, forms of discourse, writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Human factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

UNIT-III: Self Development and Assessment-
Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, taking notes; Complex problem solving; Creativity

UNIT-IV: Communication and Technical Writing-
Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

UNIT-V: Ethics-
Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, engineering ethics, managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, taking notes, Complex problem solving, Creativity.

Course Learning Outcomes (CLOs):

CLO-1: Develop the basics about organization and documents.
CLO-2: Inculcate writing skills and grammar.

CLO-3: Develop the importance of self-analysis and self-awareness.
CLO-4: Understand technical writing skills, Public speaking
CLO-5: Demonstrate ethical skills.

Text books:

(i) Raman, Singh – Business communication – Oxford Press
(ii) The sounds of English, Veena Kumar, Makaav Educational Software, New Delhi.
(iii) David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. NewYork, 2004
(iv) Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN0312406843)

Reference books:

(i) English Phonetics & Phonology, P. Roach, Cambridge University Press, London
(ii) Shiv Khera, You Can Win, Macmillan Books, New York, 2003.

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

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

Course Code: PCC BT 301 **Course Name**: Techniques in Biotechnology

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

Course Objective:

To learn different modern analytical techniques used in biotechnology and to give students a solid foundation in biology and chemistry.

Course Description:

To develop analytical and critical thinking skills in biological phenomena through scientific methods.
Student will be prepared for understanding further courses related to biochemical engineering and improvement in analytical skills.

Course Contents:

UNIT-I: Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, Electron microscopy: TEM and SEM, Atomic force microscopy and con focal scanning laser microscopy. Differential interference contrast microscopy

UNIT-II: Principle and Operations of Chromatography, Thin layer chromatography, Ion Exchange Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Filtration Chromatography, Affinity Chromatography.

UNIT-III: Electromagnetic radiation and spectrum,Atomic absorption and Atomic emission spectroscopy,Principle, working and applications of UV-VIS, NMR, ESR and IR spectrometer, Principle and applications of Mass Spectroscopy, Circular Dichorism (CD) principles, Principle and applications of Positron Emission Tomography(PET), Basics of X-Ray diffraction analysis and their application in biotechnology .

UNIT-IV: Theory of Electrophoresis, Factors affecting the migration of substances Gel electrophoresis, PAGE, SDS-PAGE, Agarose Electrophoresis of Nucleic Acid, Isoelectric Focusing of Protein Pulse Gel Electrophoresis and Western Blotting. Theory of centrifugation and sedimentation. Types of centrifuges, Preparative and analytical centrifugation; Density gradient centrifugation. Application of centrifugation for preparative and analytical purpose.

UNIT-V: Principles of 3-D printing, 3-D Bioprinting of tissues, organs and bacteria.Ideal material properties for bioprinting, Biosensors: Principles and definition, characteristics of Ideal biosensors, Biochemical components of biosensors:Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors. Principle and working of Flow Cytometry and cell sorter.

Course Learning Outcomes (CLOs):

CO1: On completion of the **courses** students will be able to understand the basic unit of the organism.

CO2: To differentiate the organisms by its cell structure.

CO3: To know Components of the Cell and their division.

CO4: To explain the arrangement of Genes and their interaction

Text books:

(i) Wilson, K, Walker, J., Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.

(ii) Sabari Ghosal & Anupama Sharma Awasthi., Fundamentals of Bioanalytical Techniques and Instrumentation, PHI learning Second edition (2018)

Reference books:

(i) Bioanalytical Techniques by A. Shourie and S S Chapadgaonkar. TERI Press. 2015

(ii) Immunoassay and Other Bioanalytical Techniques. Jeanette M. van Emon. CRC press. 2006

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

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

Course Code: PCC BT 302 **Course Name**: Microbiology and Immunology

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

Course Objective:

The course provides the students with a conceptual and experimental background in the broad discipline of microbiology. The students will be introduced to the major groups of microorganisms and their diversity in structure and functions and microbial interactions

Course Description:

Emphasis has been laid on bacterial growth, nutrition, control, metabolism, and genetics. The course also introduces the students to the scope and relevance of microbes in the field of medicine, agriculture, and industry.

Course Contents:

UNIT-I:
Morphology and Ultra structure of bacterial cell, Classification of bacteria, Culture media, Isolation of microbes and its identification, culture techniques, Preservation of cultures, Methods for the control of microbes. Enumeration of bacteria. Microbial growth kinetics.

UNIT-II:
Basic features of transduction, conjugation and transformation, Viruses: Classification and structure of viruses, Viral reproduction: lytic and lysogenic cycle, Overview of biological nitrogen fixation, Bacterial photosynthesis and electron transport system.

UNIT-III:
Introduction to immune system: Innate and Adaptive immunity, Humoral and Cell mediated immune response, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, T &B cell maturation and its activation, Characteristics and types of Antigens, Haptens, adjuvants and Epitopes, Antibodies: Structure, functions and characteristics of different classes of antibodies. Monoclonal antibodies.

UNIT-IV:
Antigen and antibody interactions, precipitation reactions , Serological techniques: ELISA, RIA and western blotting, Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Overview of Complement system and cytokines, immune tolerance.

UNIT-V:
Applications of microbiology and Immunology: Mirobiology of domestic water and waste water. Microbes in bioremediation, Microbes of industrial use, Immunity against: Bacterial disease- tuberculosis, typhoid, Protozoan disease- Malaria, Amebieosis and Viral diseases - AIDS, Dengue, Chikungunya,Vaccine's, Hypersensitivity and Immunotherapy

Course Learning Outcomes (CLOs):

CO1. Student will understand the diversified branches of microbiology
CO2. Student will know the theoretical and practical aspects of microbial growth and physiology
CO3. Students will understand the basic concept of innate and acquired immunity.
CO4. Students will gain knowledge about immunoglobulin structures and diversity of antibodies, morphology and functions of various immune cells such as dendritic cells, macrophages, neutrophils and their association with MHC molecules will be studied.

Text books:

(i) Microbiology by Pelczar (W C Brown publication)
(ii) Genral Microbiology by stainer (Mac Millan Publication)

Reference books:

(i) Microbiology by Pawar and Dagniwala (Himalaya publishing House).
(ii) Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
(iii) Immunology by C. Fatima 3. Immunology by Kuby (Free man publication)

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

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

Course Code: PCC BT 303 **Course Name**: Biochemistry

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

Course Objective:

It is intended to impart basic undergraduate-level knowledge in the area of general Biochemistry

Course Description:

Students would be able to understand the biochemical basis of cellular functions and organism physiology. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Contents:

UNIT-I:
Water - Structure, unusual properties, non-covalent interactions, role in biological processes. Ionization of Water, pH scale, Weak Acids, and Weak Bases. Buffers and buffering mechanism, Henderson Hasselbalch equation. Buffering against pH Changes in Biological Systems: Phosphate buffer, Bicarbonate buffer, Protein buffer, Amino acid Buffer & Hemoglobin Buffer System.

UNIT-II:
Carbohydrates – classification, structure and functions of monosaccharides, disaccharides and polysaccharides. Ring structure and mutarotation, stereo isomers and structural isomers. Metabolism – Glycolysis & oxidation of Pyruvate, TCA cycle, Gluconeogenesis, Pentose Phosphate Pathway, Oxidative phosphorylation, Disorder/ diseases of carbohydrate metabolism.

UNIT-III:
Fats and lipids – Classification, structure and function: Simple, Compound & Derived lipids, Essential fatty acids. Fatty acid synthesis, origin of acetyl-Co A for fat synthesis, Elongation & desaturation of Fatty Acids. Activation & transport of fatty acid from cytosol to mitochondria for oxidation. Oxidation of saturated & unsaturated fatty acids. β, α, ω oxidation. Formation and utilization of ketone bodies. Disorder/ diseases of lipid metabolism.

UNIT-IV:
Amino acids and proteins - Classification & structure of amino acids. Essential amino acids. Peptide bond formation, Ramachandran plot, Primary, secondary, tertiary & quaternary structure of proteins. Biosynthesis of amino acids from intermediates of Citric Acid Cycle & other major pathways. Biodegradation of amino acids: Deamination, transamination. Urea Cycle, Glucose-Alanine cycle. Disorder/ diseases of amino acids metabolism.

UNIT-V:
Purines and pyrimidines – Structure and properties. Metabolism of Nucleotides: Purines & Pyrimidines synthesis: de Novo & salvage pathway, Conversion of nucleoside monophosphates to nucleoside triphosphates, Formation of deoxyribonucleotides. Catabolism & salvage of Purine and Pyrimidine nucleotides. Disorder of purines and pyrimidines metabolism.

Course Learning Outcomes (CLOs):

CO1. Basic knowledge of structure and functions of major bio-molecules will make the students to understand and implement the acquired knowledge in future.
CO2. Understanding of metabolic pathways (catabolism as well as anabolism), their diversity and how these are specifically regulated and interrelated in different cells
CO3. Practical knowledge and hands on tools and techniques for the characterization of bio-molecules will help the students in advanced research programs
CO4. Concepts of enzyme kinetics, regulation and specificity

Text books:

(i) Principles of Biochemistry: A.L. Lehninger, Nelson and Cox, McMillan Worth Publishers.
(ii) Harper's Biochemistry-Rober K. Murray, Daryl K. Grammer, McGraw Hill, Lange. Medical Books. 25th edition.
(iii) Biochemistry: S.C. Rastogi – Third Edition ; Tata McGraw Hill Education Pvt. Ltd. New Delhi.

Reference books:

(i) Biochemistry: Stryer, W. H. Freeman
(ii) Biochemistry: Voet and Voet, John Wiley and Sons, Inc. USA
(iii) Biochemistry: Zubey, WCB.
(iv) Biochemistry: Garrett and Grisham, Harcourt.

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

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

TECHNIQUES IN BIOTECHNOLOGY LAB **P**
2

Subject Code: PLC-BT 321

1. Demonstration of basic concept of precision and accuracy using appropriate experimental data
2. Study of Beer-Lambert's law-using UV-Visible spectrophotometer.
3. To study principle and working of laboratory microscope.
4. To analyze the isolated plant pigments using paper chromatography.
5. Separation of amino acids using thin layer chromatography.
6. Separation of a mixture of polar and non polar compounds using column chromatographic technique.
7. To study and analysis of DNA sample by agarose gel electrophoresis.
8. To study and analysis of protein sample by SDS- PAGE
9. To study the separation of compounds using liquid-liquid extraction experiments.
10. To study the separation of biological compounds using various membrane separation.

Reference book:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry" 4 Edn., Cambridge Knew pros 1997.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : ML Srivastava; Narosa Publishing House, New Delhi.

MICROBIOLOGY& IMMUNOLOGY LAB **P 2**

Subject Code: PLC-BT 322

1. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization. (Microwave Oven, Heating mantles, Fridge, Heating Oven, Tube racks)
2. Inoculation of agar slants, agar plate and nutrient broth (Incubators, Water bath, Laminar hood, dry heat sterilizer i.e. bead sterilizer)
3. Culture of microorganisms using various techniques. (Shakers i.e. Cooling and Open shaker).
4. Simple and differential staining procedures, endospore staining, flageller staining, cell wallstaining, capsular staining, negative staining. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
5. Bacterial colony counting. (Moist chambers, spirit lamps, slides, loops & microscopes, haemocytometer)
6. Isolation of microbes from soil samples and determination of the number of colony forming units. (U.V. spectrophotometer, Colony counter etc.)
7. To determine the blood group and Rh of given blood sample.
8. To perform single radial immunodiffusion anddouble immunodiffusion
9. To perform rocket immune electrophoresis
10. To perform counter current immune electrophoresis
11. To perform ELISA

Practical Books and References:

1. Lab Manual in microbiology by P Gunasekaran (New Age Int. Pub.).

BIOCHEMISTRY LAB **P**
2

Subject Code: PLC-BT 323

1. Preparation of solutions: 1) Percentage solutions, 2) Molar solutions, 3) Normal solutions
2. Spectroscopy: Determination of absorption maxima (λmax) of a given solution
3. Titration of weak acid-weak base
4. Quantitative estimation of carbohydrates
5. Distinguish reducing and non-reducing sugars
6. Quantitative estimation of proteins
7. Estimation of nucleic acids
8. Isoelectric precipitation
9. Separation of sugars, fatty acids and amino acids by paper chromatography
10. Extraction of lipids from plant material
11. Thin layer chromatography
12. Gel electrophoresis

Reference books:

1. Wilson and Walker, "Principles and Techniques of Practical Biochemistry", 4 Edn., Cambridge Knew pros 1997.

2. Plummer DT, "An Introduction to Practical Biochemistry", III Edn., Tata McGraw hill**.**

SEMESTER IV

Course Code: ECS 202 **Course Name:** Mathematics-V
Course Credit Hour: 4hr **Total Contact Hour:** 40hrs

Course Objective:

The main objective of this course is to provide students with the probabilistic and statistical analysis mostly used in varied applications in engineering and sciences and it provide the methods of organizing and simplifying data so that their significance is comprehensible.

Course Description:

This course provides an introduction to probability and statistics with applications. Topics include: random variables, continuous and bivariate probability distributions, Bayesian inference, hypothesis testing, confidence intervals, curve fitting and regression.

Course Contents:

UNIT-I: Basic Probability (12 hours)
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

UNIT-II: Continuous Probability Distributions (4 hours)
Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

UNIT-III: Bivariate Distributions (4 hours)
Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

UNIT-IV: Basic Statistics (8 hours)
Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-V: Applied Statistics (8 hours)
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

UNIT-VI: Small samples (4 hours)
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Course Learning Outcomes (CLOs):

CLO-1: Recognize basic probability theory and its application.
CLO-2: calculate Continuous Probability Distributions and their properties.

CLO-3: Calculate bivariate distributions and their properties with applications.
CLO-4: Basic concept of Statistics, Probability distribution and correlation.
CLO-5: Fitting the data and large sample testing.
CLO-6: Testing the hypothesis for Small samples

Text books:

(i) Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
(ii) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers
(iii) S. Ross, "A First Course in Probability", Pearson Education India,

Reference books:

(i) Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,
(ii) W. Feller, "An Introduction to Probability Theory and its Applications", Wiley,

Online links for study & reference materials:
https://nptel.ac.in/courses/111/105/111105041/

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

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

Course Code: HSMC 201 **Course Name:** Human Values

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

Course Objective:

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

Course Description:

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

Course Contents:

UNIT-I: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4.Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5.Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II: Understanding Harmony in the Human Being - Harmony in Myself!

1.Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2.Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3.Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4.Understanding the characteristics and activities of 'I' and harmony in 'I'.
5.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

UNIT-III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1.Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2.Understanding the meaning of Trust; Difference between intention and competence 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4.Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5.

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence
1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3.Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. 4.Holistic perception of harmony at all levels of existence.

UNIT-V: Implications of the above Holistic Understanding of Harmony on Professional Ethics
1.Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems

Course Learning Outcomes (CLOs):

CLO-1: Develop the basic concept of human values
CLO-2: To understand the importance of self-exploration process
CLO-3: To understand harmony at individual levels
CLO-4: To understand harmony at nature level
CLO-5: Develop professional ethics

Textbooks:

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

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

Course Code: PCC BT 401 **Course Name:** Bioprocess Engineering I

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

Course Objective:

Course Objective is to provide basic concepts of bioprocess engineering to the students. They will learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry.

Course Description:

The students will learn the basics of bioreactor design and operation control that have been applied to a variety of bioprocess industries and also conduct related experiments for better understanding

Course Contents:

UNIT-I:
Fluid Properties: Viscosity, Newton's Law of viscosity, Kinematic Viscosity, Rheological Diagram, Euler Equation and its application, Derivation of Bernoulli Equation from Euler Equation, Applications of Bernoulli's Theorem, Pascal's Law, Hydrostatic Law. Measurement of Pressure: Definition of Gauge and & Absolute Pressure, Barometer, Various Manometers (Peizometer, U-tube manometer, Single column manometers, U-tube & Inverted U-tube differential manometers) & their industrial applications.

UNIT-II:
Flow Measuring Equipment: Head Flow Meters, Nozzel Meter, Orifice Meter, Venturi Meter, Area Flow Meters, Rotameter, Pitot Tube & Applications of these equipments. Pipe fittings, major and minor losses in pipe flow, Calculation of Pressure Drop in a Pipe, Equivalent Length & 'K' factor, Methods of finding dimensional numbers - methods of governing equations, Method of force ratios and Buckingham's π method. Reciprocating pump & its applications. Centrifugal Pumps and its applications.

UNIT-III:
Conduction and Convection Introduction. Basic concepts of conduction in solids, liquids and gases, One and two dimensional heat conduction. Critical and optimum insulation thickness. Introduction to unsteady state heat transfer. Principles of convection, Equations of forced and free convection, Heat flow due to conduction & convection. Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, solar radiations, combined heat transfer coefficients by convection and radiation. Heat Transfer Equipments: Double pipe, Shell & tube and Plate type heat exchanger, Evaporator, Condenser

UNIT-IV:
Diffusion: Fick's Law, steady state diffusion: Rectangular, cylindrical, spherical (1-D); diffusion with reaction, both at surfaces, and in the bulk medium.Transient conduction and diffusion: Basics of Fourier analysis, unsteady state conduction and diffusion (1-D), transient conduction/diffusion with generation/reaction.

UNIT-V:

Mass transfer coefficients, Mass transfer in fluidized bed reactor, flow past solids and boundary layers, Simultaneous heat and mass transfer system. Mass transport in Biomedical and Biological Engineering: Haemodialysis, Diffusion and uptake of ligands by cells, oxygen transport in tissue and capillaries.

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

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

Course Learning Outcomes (CLOs):

C01: At the end of this course, the students will learn the basics of bioprocess engineering.

CO2: Will also learn the principle, design, and operation control of various types of bioreactors and their scale-up strategies.

CO3: Develop skills to understand Bioprrocess Engineering at Industrial level for its applications.

Text books:

(i) Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).
(ii) Treybal, R "Mass Transfer Operations", 3rd ed. New York: McGraw-Hill, (1980).
(iii) Introduction of Fluid Mechanics by Robert W.Fox and Slan T. McDonald, John willey & sons, Ny. Fourth Ed.
(iv) Unit Operation in Chemical Engg., McCabe Smith Vth Ed.
(v) Foust A. S. et.al., "Principles of Unit Operations" John Wiley (1980)

Reference books:

(i) Holman, J.P.: "Heat Transfer" 9 th ed. McGraw Hill (1989).

Course Code: PCC BT 402 **Course Name**: Genetics and Molecular Biology

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

Course Objective:

To provide students the knowledge about gene organization, genetic materials, molecular heritance, gene transfer, and their regulations. To provide students the knowledge about cellular content, organization, structures, and functions.

Course Description:

This **course** serves as a broad introduction to the structure and function of nucleic acids, basic processes that regulate expression of **genetic information**, **biological** processes that direct inheritance of **genetic information**, and the outcome of those processes – inherited traits

Course Contents:

UNIT-I:

Fundamental principles of genetics, gene interaction, multiple alleles, complementation, linkage, recombination and linkage mapping, extra-chromosomal inheritance, chromosomes basis of heredity, Sex determination, sex linked, sex limited and sex, influenced inheritance.

UNIT-II:

Genome organization: Genome organization in prokaryotes and eukaryotes - special features of eukaryotic gene structure and organization, genome organization in mitochondria and chloroplast, DNA content and C-value paradox. Methods to measure DNA content variation - Various types of DNA sequences (simple sequences, repetitive sequences, nonsense sequences, tandem gene clusters, satellites)

UNIT-III:

Gene structure, DNA & RNA as a genetic material, packaging of DNA as chromosome, central dogma of molecular biology, DNA replication, DNA repair. Linkage and recombination, crossing over and genetic mapping, gene mapping by two point and three point test crosses, Cell cycle regulation and apoptosis.

UNIT-IV:

Genetic mutation, micro-deletion, Genetic syndrome, Techniques to detect mutation, Transcription in prokaryotes and eukaryotes, genetic code, reverse transcription, mRNA processing. Role of sigma factor in transcription, role of promoters and enhancers, mechanism and regulation of transcription in prokaryotes and eukaryotes.

UNIT-V:

DNA replication process in prokaryotes & Eukaryotes, Activity of DNA polymerases and topoisomerases, Reverse transcriptase, Translation in prokaryotes and eukaryotes Basic principles of gene cloning and r-DNA technology, genetic code, properties of genetic code, wobble hypothesis, Molecular chaperones.

Course Learning Outcomes (CLOs):

CO1. Students will know about the cell and its biology, which will help the students to understand the origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function – how they obtain energy, synthesize new molecules, communicate, proliferate and survive.
CO2. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
CO3. Students will learn DNA replication, recombination and repair, transcription and translation
CO4. Students will be aware of the modern tools and techniques of genomics and isolation and identification of genes

Text books:

(i) Genetics a conceptual approach, 2nd Edition Benjamin A. Pierc WH freeman and, company, New York.
(ii) Benjamin Levin – Genes VIII, 8 th ed.

Reference books:

(i) Albert B, Bray Denis et al.: Molecular Biology of the Cell, latest ed.
(ii) Watson, Hopkins, Roberts et al.: Molecular Biology of the Gene, 4 th ed.
(iii) Genetics- Strickberger, 2nd.
(iv) Baltimore- Molecular Biology of the Cell.
(v) Advance Genetics by G.S. Miglani, Narosa Publishing House.

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

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

Course Code: PCC BT 30 **Course Name**: Enzyme Engineering
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course provides the theory and knowledge relevant to the enzymology principles including fundamental properties of enzymes, enzyme catalytic mechanisms and enzyme kinetics. Finally this course serves to provide an awareness of the current and possible future applications of enzyme technologies.

Course Description:

This **course** covers basics and applications concerning enzymes. The knowledge of inorganic chemistry, physical chemistry, organic chemistry and biochemistry will be applied to the understand enzymes. ... It is to cultivate the human resources who can lead advanced science and **engineering** through the studies of enzymes.

Course Contents:

UNIT-I:
Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate-lock and key model, induced fit model. Features of active site, activation energy, enzyme specificity and types. IUB system of classification and nomenclature of enzymes. Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Numerical related to enzyme kinetics, Multi-Substrate reac0tion mechanisms.

UNIT-II:
Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Allosteric regulation of enzymes, concerted & sequential model; Deactivation Kinetics.

UNIT-III:
Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods. Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

UNIT-IV:
Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

UNIT-V:
Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Course Learning Outcomes (CLOs):

CO1. Distinguish the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms
CO2. Apply biochemical calculation for enzyme kinetics
CO3. Compare methods for production, purification, characterization and immobilization of enzyme.
CO4. Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

Text books:

(i) Fundamentals of enzymology by Nicolas C. price and Lewis stevens. Oxford University Press
(ii) Enzymes by Trevor palmer, East west Press
(iii) Enzyme Technology by Messing

Reference books:

(i) Enzymes: Dixon and Webb. (IRL Press)
(ii) Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
(iii) Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

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

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

Course Code: MC-02 **Course Name:** Python
Course Credit Hour: 3hr **Total Contact Hour:** 34hr

Course Objective:

- Master the fundamentals of writing Python programs
- Learn basic Python coding elements such as variables, identifiers and flow control structures.
- Discover how to work with lists and sequence data.
- Write Python functions to facilitate code reuse.
- Work with the Python standard library
- Explore Python's object-oriented features

Course Description:

This is an introductory course designed for any student interested in using computation to enhance their problem solving abilities. No prior experience in programming is necessary. Students will use their problem solving abilities to implement programs in Python. This course will develop a basic understanding the Python programming language

Course Contents:

UNIT-I:

Introduction to Python: - History of python programming language, thrust areas of python, overview of programming in Python, identifiers, variables, Expressions and statements, Operators and Operands, data types, indentation, comments, reading input.

UNIT-II:

Control flow Statements:-if statement, if-else statement, if-else-elif control flow statement, nested if statement, the while loops, the for loop, Strings: Creating and storing strings, basic string operations, formatting strings and string operations.

UNIT-III:

Functions: Built in functions, function definition and calling the function, default parameters, Lists: Creating list, basic list operations, build in functions used in list, list methods, Dictionaries: Creating dictionaries, built on functions used in dictionaries, dictionary methods.

UNIT-IV:

Tuples: Creates tuples, basic tuple operations, tuple methods, Sets: set methods, Basics Object – oriented Programming: classes and objects, creating classes and objects in python, classes with multiple objects, class attributes vs. data attributes.

Course Learning Outcomes (CLOs):

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

- Understand python identifiers, variables, Expressions, statements, Operators, operand and data types.
- Implement Conditionals and Loops for Python Programs.
- Use functions and represent Compound data using Lists, Tuples, Dictionaries and strings.
- Implement basics object –oriented components.

Text books:

(i) Bill Lubanovic, Introducing Python- Modern Computing in Simple Packages, O'Reilly Publication.

(ii) Wesley J. Chun, Core Python Programming, 2nd Edition, Pearson Education.

Reference books:

(i) Guido Van Russom, Fred L. Drake, An Introduction to Python, Network Theory Limited.

(ii) Magnus Lie Hetland, Beginning Python: From Novice To Professional, Pearson Education.

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

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

Bioprocess Engineering Lab-I **P 2**

1. To find the thermal conductivity of liquid / gases
2. To determine the local velocity pressure with the help of pilot tube
3. To find out the thermal conductivities of Metal rod
4. To study the characteristics of a centrifugal pump.
5. To determine the viscosity of a given viscous liquid by capillary tube flow method.
6. To differentiate between laminar and turbulent flow using Reynolds experiment.
7. To determine velocity through orifice meter, venture meter
8. To determine the overall heat transfer coefficient in Parallel flow heat exchanger/counter flow heat exchanger
9. To determine the drying characteristics of given sample
10. To determine the minimum fluidization velocity in a fluidized bed and verifyexperimentally

GENETICS & MOLECULAR BIOLOGY LAB **P 2**

1. How to calculate genetics and allelic frequencies numeric problem analysis.
2. Isolation of Plasmid DNA
3. Isolation of Plant DNA
4. Estimation of DNA content in the given sample by spectrophotometer
5. Determination of Tm of DNA.
6. Isolation of bacterial genomic DNA.
7. Purification of DNA through Electrophoresis & visualization under UV transilluminator.
8. Polyacrylamide gel electrophoresis of DNA.
9. PCR amplification of DNA and visualization by gel electrophoresis.
10. Isolation and study of polytene chromosome in Drosophila.

ENZYME ENGINEERING LAB

P
2

1. Production of commercially important enzymes from microbial sources.

2. Isolation of alpha amylase from plant source

3. Determination of enzyme activity and specific activity.

4. Partial purification of isolated enzymes.

5. Method of checking the purity of the enzyme -SDS-PAGE

6. Characterization of enzymes-effect of pH , temperature and inhibitors on enzyme activity etc.

7. Identification of Enzyme by different assay

8. Purification of enzymes by different methods

9. Immobilization of enzymes –Different Techniques such as adsorption entrapment, encapsulation and cross-linking.

10. Strain improvement techniques- physical, chemical and genetic manipulation methods.

11. Formulation of enzyme stability.

12. Enzyme inhibition

SEMESTER V

Course Code: PCC BT 501 **Course Name**: Genetic Engineering

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

Course Objective:

The student would be able to understand the working details of the cloning of a gene. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Description:

It is intended to impart basic undergraduate-level knowledge in the area of molecular biology and recombinant DNA technology. The use of virtual lab and computational tools would enable them to perform *in silico* cloning of the selected DNA.

Course Contents:

UNIT-I:
Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters, promoter analysis (EMSA and DNA footprinting); Introduction of recombinant DNA in to host cells and selection methods.

UNIT-II:
Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antisera.;cloning of insulin gene and other genes of commercial interest, strain improvement of industrially important organisms.

UNIT-III:
Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons, Applications of PCR; Site directed mutagenesis.; molecular markers (RAPD, RFLP, AFLP, SNP)

UNIT-IV:
Applications of genetic engineering; Creation of recombinant microorganisms, transgenic plants and animals; cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Gene therapy; DNA drugs and vaccines.

Course Learning Outcomes (CLOs):

CO1. Students will become familiar with the tools and techniques of genetic engineering DNA manipulation enzymes, genome and transcriptome analysis and manipulation tools, gene expression regulation, production and characterization of recombinant proteins.
CO2. This course exposes students to the applications of genetic engineering in biological research.
CO3. Students will be able to perform basic genetic engineering experiments at the end of course.
CO4. Students will acquire knowledge of advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.

Text books:

(i) T.A Brown (2006). Gene cloning and DNA analysis, WILEY- BLACKWELL
(ii) 0Molecular Biology of the Cell by Bruce Alberts.6th edition

Reference books:

(i) Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition (Vol.1,2,3) S.B Primrose (2001). Molecular biotechnology.Panima Publishing
(ii) corporation, 2ndedition
(iii) Genetic Engineering by Dr Smita Rastogi & Dr Neelam Pathak, Oxford University Press

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

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

Course Code: PCC BT 502 **Course Name**: Fermentation Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The objective of this course is to study the principle of sterilization necessary for **fermentation**. To study the cell growth and product formation. To evaluate the kinetics and mechanism of microbial growth.

Course Description:

This **course** emphasizes the application of biological and engineering principles to problems involving microbial, mammalian, and biological/biochemical systems. The aim of the **course** is to review fundamentals and provide an up-to-date account of current knowledge in biological and biochemical technology.

Course Contents:

UNIT-I:
Introduction to fermentation technology: Interaction between Bio-chemical engineering, Microbiology and Biochemistry. History and development of fermentation industry: Microbial culture selection for fermentation processes, Strain development; Preservation and improvement of industrially important microorganisms**.**

UNIT-II:
Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples

UNIT-III:
Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.

UNIT-IV:
Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect, feedback inhibition and feedback repression;Concept for overproduction ofprimary and secondary metabolites.

UNIT-V:
Details of the process, parameters and materials -for the industrial manufacture of Antibiotics (β-lactum), Solvents (acetone) Amino acid (Lysine), Organic acids (Citric acid), Alcohols (Ethanol), Ind. Enzymes (Protease/Amylase) and Biopharmaceuticals (Insulin/Interferon etc.)-Microbial Transformations, Microbial leaching.

Course Learning Outcomes (CLOs):

CO1: To study the design and construction of fermentor and parameters to be monitored and controlled in fermentation process..
CO2: To study the principle of sterilization necessary for fermentation.
CO3: To study the cell growth and product formation.
CO4: To evaluate the kinetics and mechanism of microbial growth..

Text books:

(i) Murray Moo -Young , Comprehensive Biotechnology, Vol. 1 & III-latest ed.
(ii) Principles of Fermentation Technology-Whitaker & Stanbury

Reference books:

(i) Industrial Fermentations-Leland, N. Y. Chemical Publishers.
(ii) Prescott and Dunn's-Industrial Microbiology, 4 th, ed.
(iii) Biotechnology Series, Rehm, Reed &Weinheim, Verlag-Chemie.

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

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

Course Code: PCC BT 503 **Course Name**: Bioinformatics I

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

Course Objective:

This course is beneficial for students to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms.

Course Description:

This course is a survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine. This course will build the foundation of sequence alignment techniques and find evolutionary connections. It will help students to analyze mRNA expression data and gene annotations.

Course Contents:

UNIT-I:

Introduction to Bioinformatics; Biological databases: Nucleotide databases, Protein databases, Specialized databases; Laboratory data submission and data retrieval; Various file formats for biomolecular sequences: Genbank, EMBL, FASTA, GCG, msf, nbrf-pir etc.; Basic concepts of sequence similarity: identity and homology, definitions of homologues, orthologues, paralogues; Sequence patterns and profiles

UNIT-II:

Sequence Alignment and Database Searching: Introduction, Evolutionary Basis of Sequence Alignment, Optimal alignment method, Statistical Significance of Alignment. Database searching Artifacts; Database similarity searching: FASTA, BLAST, Various versions of basic BLAST and FASTA, Advance version of BLAST: PHI-BLAST and profile-based database searches using PSIBLAST; Multiple sequence alignment: progressive method and Iterative method; Applications of pairwise and multiple sequence alignment; Tools for multiple sequence alignment: CLUSTALW and Pileup (Algorithmic concepts).

UNIT-III:

Scoring Matrices: Basic concept of a scoring matrix, Similarity and distance matrix, Substitution matrices: Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, Principles based on which these matrices are derived and Gap Penalty; Predictive Method using Nucleotide Sequence: Introduction, marking repetitive DNA, Database search, Codon bias detection, detecting functional site in DNA

UNIT-IV:

Phylogenetics: Phylogeny and concepts in molecular evolution; nature of data used in taxonomy and phylogeny; definition and description of Phylogenetic trees and various types of trees; Different methods of Phylogenetic tree construction: UPGMA and Fitch-Margoliash Algorithm; case studies in phylogenetic sequence analysis.

UNIT-V:

Protein identification based on composition, Physical properties based on sequence, Motif and pattern, Secondary structure (Statistical method: Chou Fasman and GOR method, Neural Network and Nearest neighbor method) and folding classes, specialized structure or features, Tertiary structures (Homology Modeling); Structure visualization methods (RASMOL, CHIME etc.); Protein Structure alignment and analysis. Application of bioinformatics in drug discovery and drug designing.

Course Learning Outcomes (CLOs):

CO1: After completing this course student will perform computational analyses of biological sequences, genome-wide studies
CO2: Relate the results to core principles of biology; use computational methods to help execute a biological research plan
CO3: Analyze biological problems and data using the latest machine learning and deep learning techniques.
CO4: Understand the notion of similarity, identity, and gaps in the context of sequence alignment and deduce evolutionary relationships among sequences; analyze microarray and RNA-seq gene expression data.

Text books:

(i) D.W.Mount; Bioinformatics-Sequence and genome analysis; Cold Spring
(ii) HarbourLab press.
(iii) B.N.Mishra; Bioinformatics: Concept and application, Pearson Education (in press)

Reference books:

(i) O' Reilly; Developing Bioinformatics computer skills-1stIndian edition, SPD publication.

(ii) Anthony J.F. Griffiths et al; An introduction to genetic analysis, 1stEd

(iii) Michael Starkey and Ramnath Elaswarapu; Genomics protocols, Humana press

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

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

Course Code: DE BT 11 **Course Name**: Pharmaceutical Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The science of Pharmaceutical biotechnology is a dynamic science aims at focusing the attention of students at some basic knowledge about biological techniques used in production some of biological drugs as Penicillin and monoclonal antibodies and some basic principles and definitions related to Pharmaceutical biotechnology as tissue culture and genetic engineering.

Course Description:

The **Pharmaceutical Biotechnology course** is a mixture of molecular biology and **biotechnology**. ... It involves the study of microorganisms, living organisms, pharmaceutics, pharmacogenomics, and other **pharmaceutical** drugs.

Course Contents:

UNIT-I:
Introduction to drugs and pharmacy: An overview and history of pharmaceutical industry. Introduction: Therapeutic categories such as Analgesics, Anticancer, Antiviral, Anticoagulant, Analgesics, Antibiotics, Use of therapeuticagents, Biopharmaceuticals.

UNIT-II:
Bulk drug manufacturers, Type of reactions in bulk drug manufacture and processes. Specialrequirement for bulk drug manufacture.

UNIT-III:
Compressed table, wet granulation-dry granulation or slugging-direct compression-tablet presses,coating of tablets, capsules, sustained action dosage forms-parental solution-oral liquidsinjections-ointment-topical applications, Preservation, analytical methods and test
for variousdrug and pharmaceuticals, packing-packing techniques, quality management.

UNIT-IV:
New drug development and approval process: Strategies for new drug discovery, finding a
lead compound, combinatorial approaches to new drug discovery, pre-clinical and clinical trials, GMP, Economics of drug development.

UNIT-V:
The business and the future of Biopharmaceuticals. Drug regulation and control.Scope and
applications of biotechnology in pharmacy.

Course Learning Outcomes (CLOs):

CO1: Acquire knowledge in basic principles of genetic engineering and enzyme technology
CO2: Apply the principles of biosensors and protein engineering in Pharmaceutical Industry
CO3: Explain the concepts of rDNA technology and its applications
CO4: Describe the concept of immunity and production of vaccine.

Text books:

(i) Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology, Wiley (1998).

(ii) Leon Lachman et al :Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986

Reference books:

(i) Remington's Pharmaceutical Science, Mark Publishing and Co

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

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

Course Code: DE BT 12 **Course Name**: Nano Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The objective of this course is to have knowledge of the Nanoscience and related fields. To make the students acquire an understanding the Nanoscience and Applications and also to help them understand in broad outline of Nanoscience and **Nanotechnology**.

Course Description:

Nanotechnology illustrated with original scientific literature; experimental techniques that can be used to study nanoscale materials and phenomena; material properties on the nanoscale

Course Contents:

UNIT-I:
Nanobiotechnology, History, Origin, Fundamental Concepts, Bottom- up versus Top-down approaches, Discussion on Micro and Nanofabrication, Current research, Tool and Techniques, Applications and Implications and Nanofabrication.

UNIT-II:
Carbon nanotubes and related structures, Properties, Synthesis, Applications, Metal nanoparticles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles and Nano chemicals.

UNIT-III:
Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), improved nanodiagnostic devices, Drug delivery tools through nanotechnology

UNIT-IV:
Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas

UNIT-V: V:
Micro and Nano biosensor, Bioavailability, Nanoimaging agents, Tumor Targeting through nanotechnology, Quantam dots technology and its applications

Course Learning Outcomes (CLOs):

CO1. Students will understand the fundamental principles of nanotechnology and their application to biomedical engineering.
CO2. Students will gain knowledge about state-of-the-art nano-fabrication methods
CO3. This course will offer students a comprehensive package of knowledge about the characterization methods for nanomaterials, critiquing nanomaterial safety and handling methods required during characterization

Text books:

(i) Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.

(ii) Guozhong Cao ,"Nanostructures and Nanomaterials , synthesis , properties and applications" , Imperial College Press ,2004.

(iii) Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press,2002

Reference books:

(i) Microfabrication and Nanomanufacturing- Mark James Jackson.

(ii) MEMS and Nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.

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

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

Course Code: DE BT 13 **Course Name**: Biomedical Instrumentation
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The course has the following objectives:

- To introduce a fundamentals of transducers as applicable to physiology
- To explore the human body parameter measurements setups
- To make the students understand the basic concepts of forensic techniques.

Course Description:

The **course** is designed to give the basic concepts of **Instrumentation** involved in **medical** field and human physiology. **Biomedical Instrumentation** is application of technology for **Medical** field. The **course** will make the students understand the devices used in diagnosing the diseases

Course Contents:

UNIT I:
History and development of biomedical instrumentation, biometrics, Basic transducer principles: active and passive transducers, tranducers for biomedical applications; origin of biopotential and its propagation, sources of bioelectric potentials, electrocardiogram, electro encephalogram, electromayogram and other bioelectric potentials. Biopotential Electrodes: types of electrodessurface, needle and microelectrodes, biochemical tranducers.

UNIT II:
The Cardiovascular system, Cardiovascular measurements: electrocardiography, measurement of blood pressure, measurement of blood flow and cardiac output, plethymography, measurement of heart sounds; Patient care and monitoring: elements of intensive care unit, pacemakers and defibrillators , Measurements in the respiratory system: mechanics of breathing, gas exchange and distribution, respiratory therapy equipment.

UNIT III:
Non-invasive diagnostic instrumentation: Temperature measurements ultrasonic measurements, the nervous system and neuronal communication measurement in nervous systems,Instrumentation for sensory measurements and the study of behaviors, pshycophysiological measurements, Biotelemetry.

UNIT IV:
Instrumentation for the clinical laboratory, Automation of chemical tests, Biomedical instruments for surgery, Haemodialysis machines. X-ray machines and digital radiography.

UNIT V:
Medical Imaging equipments, the computer in biomedical instrumentation and applications, microprocessors, Electrical safety of medical equipment, physiological effects of electric current

Course Learning Outcomes (CLOs):

CO1: Understand the physiology of biomedical system
CO2: Measure biomedical and physiological information.
CO3: Discuss the application of Electronics in diagnostics and therapeutic area

Text books:

(i) Biomedical Instrumentation and Measurement by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer
(ii) Biomedical Instrumentation: Technology and Applications by Raghbir Singh
(iii) Medical Instrumentation for Health Care by Leslie Cromwell

Reference books:

(i) Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation by Robert B. Northrop

(ii) Introduction to Bioinstrumentation: With Biological, Environmental, and Medical Application by Clifford D. Ferris.

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

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

Course Code: DE BT 14 **Course Name**: Metabolic Engineering
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

Metabolic engineering is an emerging field of biotechnology/bioprocess engineering which aims towards purposeful modification of cellular (metabolic, gene regulatory, and signalling) processes/networks to achieve desirable goals such as enhanced production of metabolites including pharmaceuticals, biofuels and biochemicals and other biotechnology products.

Course Description:

This course aims to provide fundamental and advanced knowledge in the development of microbial strain for bio production through metabolic engineering.

Course Contents:

UNIT I:
Basic concept of metabolism, anabolism & catabolism, Importance of metabolic engineering General Principles of Intermediary Metabolism, Regulation of Pathways, Strategies for Pathway Analysis.Understanding the role of Bioinformatics in the study of metabolic pathways.

UNIT II:
Synthesis of primary metabolites: Amino acid synthesis pathways and its regulation at enzyme level and whole cell level, Alteration of feedback regulation, Limiting accumulation of end products

UNIT III:
Biosynthesis of secondary metabolites: Regulation of secondary metabolite pathways, precursor effects, prophase, idiophase relationship, producers of secondary metabolites, applications of secondary metabolites.

UNIT IV:
Bioconversions: Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances

UNIT V:
Regulation of enzyme production: Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway manipulations to improve fermentation, Feedback repression, Catabolite Repression, optimization and control of metabolic activities.

Course Learning Outcomes (CLOs):

CO1: Describe the design-build-test-learn cycle of metabolic engineering.
CO2: Understand the principles of enzyme function, kinetics and regulation.
CO3: Describe metabolic physiology in a quantitative manner.
CO4: Describe metabolic networks computationally as stoichiometric and kinetic models.

Text books:

(i) G. Stephanopoulos, A. Aristidou and J. Nielsen, Metabolic Engineering Principles and Methodologies, Academic Press, 1998

(ii) Daniel I. C. Wang, Malcolm D. Lilly, Arthur E. Humphrey, Peter Dunnill,

(iii) Arnold l.Demain, Fermentation and Enzyme Technology,1st edition John Wiley& Sons, Reprint, 2005

Reference books:

(i) Christina Smolke, The Metabolic Pathway Engineering Handbook (Two Volume) Set 1st edition CRC press, 2009.

(ii) Stanbury P. F. and Whitaker A., Principles of Fermentation Technology, Pergamon Press,1984.

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

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

Course Code: DE BT 21 **Course Name**: Biofuels & Alcohol Technology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course "focuses on combustion fuels made from nonpetroleum sources and introduces the sources, processing, and social impacts of biofuel utilization." The materials included are intended to provide instructors with content to teach a 3-credit course.

Course Description:

Engaged in academic, research & development and extension activities in the area of alcohol production, distillery effluent treatment, biofuels & byproducts. To undertake research for developing cost-effective alcohol production technologies from alternate raw materials.

Course Contents:

UNIT I:
Introduction to Alcohol Technology, Raw Material of Alcohol Industry, Storage & handling of Raw material in detail, Study of different yeast strains used in alcohol industries, Study of yeast production as single protein cell.

UNIT II:
Study of different alcoholic fermentation techniques, Batch fermentation, Continuous fermentation, Modem techniques of Continuous fermentation, Bio still fermentation, Encillium process, Wet milling of grain for alcohol production, Grain dry milling cooking for alcohol production, Use of cellulosic feed stocks for alcohol production, Scaling in distilleries, Fusel oil separation

UNIT III:
Study of different recycling process, Biochemistry of alcohol production, The management of fermentation in the production of alcohol. Alcohol distillation-The fundamental, Parameters & affecting alcoholic fermentations, By product of alcoholic fermentation, Distillery quality control, Alcoholometry

UNIT IV:
Various biofuels/ bioenergy from biomass. Biomass conversion to heat and power: thermal gasification of biomass, anaerobic digestion. Biomass conversion to biofuel: thermochemical conversion, syngas fermentation.

Course Learning Outcomes (CLOs):

CO1: At the end of the course students will be able to describe how petroleum and bio-based fuels affect the global carbon cycle.
CO2: the attributes of biofuels that make them suitable as a fuel for a specific application
CO3: limitations of biofuels, global impacts of biofuels on food and energy supplies
CO4: technological advances and challenges to be overcome for a wide-scale biofuel adoption."

Text books:

(i) Chemical Process Principles – Part I, Material and Energy Balances by Olaf A Hougen, Kwenneth M. Watson, and Roland A Ragatz, CBS
(ii) Publishers and Distributors (1995).
(iii) He alcohol text book by Kathryn AnnJacques, T. P. Lyons, D. R. Kelsall
(iv) Product Recovery in Bioprocess Technology ", BIOTOL Series, VCH, 1990

Reference books:

(i) Shreve's Chemical Process Industries , 5th Ed. Reference
(ii) Outlines of Chemical Technology by Charles E. Dryden

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

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

Course Code: DE BT 22 **Course Name**: Descriptive Statistics & Process Control
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

This course should have an enhanced knowledge and understanding of mathematical modeling and statistical methods in the analysis of biological systems and be aware of the use of computers to assist them in studying mathematical functions and carrying out statistical tests.

Course Description:

The course provides an overview of the methodology used to evaluate a process using statistical methods, and using this information to evaluate and take action on both the process and the output from the process.

Course Contents:

UNIT I: Descriptive Statistics:
Diagrammatic and graphical representation of numerical data, Formation of frequency distribution, histogram, cumulative frequency distribution, polygon and O-give curve, measures of central tendencies – mean, median, mode. Measures of dispersion: mean deviation, standard deviation, variance, quartile deviation and coefficient variance, Moments (up to 4th), Measures of skewness and kurtosis for grouped and ungrouped data.

UNIT II: Probability & Hypothesis Testing:
Concept of Probability – Classical definition, Basic theorems of probability, Types of probability, Conditional probability, Theorem of total probability, Normal Distribution, The Central Limit Theorem, Binomial distribution, Poisson's Distribution, The Poisson's approximation to the Binomial Distribution. Testing of significance, large sample test for population mean and proportions, Test of population means-single, two samples, and paired t-test, chi square test. ANOVA

UNIT III: Correlation and Regression analysis:
Product moment and rank, correlation coefficient, simple regression, method of least squares for estimation of regression coefficients, concept of sampling and sampling distribution, sampling from nominal distribution, standard error

UNIT IV: Design of Experiments (DOE):
Design of Experiments (DOE) approach to optimization - traditional (linear) approach (OFAT) and multi-dimensional approach (Box-Bhenken Design, central composite design, Plackett-Burman Design, Downhill Method, Full factorial, Fractional factorial design)

UNIT V: Control Charts:
Introduction to statistical process control and capability analysis: Chance and assignable cause of quality variation, Statistical basis of process monitoring: control chart, choice of control charts, analysis of control chart, variable of control charts, X bar and R chart, Attribute control chart, Determining process and measurement capability

Course Learning Outcomes (CLOs):

CO1. Students will understand and apply statistical methods for the design of biomedical research and analysis of biomedical research data
CO2. Students will learn the use of mathematical and statistical theory and application of biostatistical methods; use & interpret results from specialized computer software for the management and statistical analysis of research data
CO3. Students will learn to participate in a research team setting in study design, data coordination and management and statistical analysis and reporting of study results
CO4. Students will participate in a research team for the development and evaluation of new and existing statistical methodology

(i) Snedecor G. W. and Chochran W. G., Statistical Methods, 1989.

(ii) Douglas C Montgomery: Statistical Quality Control 7thedn.

Text books:

Reference books:

(i) Douglas C Montgomery: Applied statistics and Probability for engineers, 4thedn

(ii) TT Soong: Fundamentals of probability and statistics for engineers

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

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

Course Code: DE BT 23 **Course Name**:3D Printing Techniques

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

Course Objective:

The student will be able to gain knowledge and skills related to 3D printing technologies. environment. To understand the various software tools, process and techniques for digital manufacturing. To apply these techniques into various applications.

Course Description:

To understand the various software tools, **process** and **techniques** for digital manufacturing. To apply these **techniques** into various applications. After completion of this **course**, the students will be able to: •Develop CAD models for **3D printing**. ... Produce a product using **3D Printing** or **Additive Manufacturing** (AM).

UNIT I:

Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields

UNIT II:

Liquid based systems: Stereo lithography apparatus (SLA): Models and specifications, process,working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies.

UNIT III:

Solid based systems: Laminated object manufacturing(LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies.Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

UNIT IV:

Powder Based Systems: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Course Content:

Course Learning Outcomes (CLOs):

After completion of this course:
CO1: The students will be able to Develop CAD models for 3D printing.
CO2: Import and Export CAD data and generate. stl file.
CO3: Select a specific material for the given application.
CO4: Select a 3D printing process for an application.

Text books:

(i) Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles and App0lications, World Scientific publications, 3rdEd., 2010

(ii) D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001

(iii) Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000

Reference books:

(i) Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996

(ii) Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

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

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

Course Code: PCC BT 501 **Course Name**: Molecular Modeling & Drug Design

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

Course Objective: The objective of this course i.e., Molecular Modeling deals with the ways to mimic the behaviours of molecules and molecular systems. It is invariably associated with computer modeling and has been revolutionized by computational techniques to the extent that most of the calculations could not be performed without the use of a computer, and thus computers have extended the range of models that can be considered and the systems to which they can be applied

Course Description:

The course covers advanced methods and strategies used in medicinal chemistry research with a focus on computer-aided drug design. The course includes protein-ligand interactions, docking, chemo-informatics, molecular dynamics simulations, free energy calculations, and chemigraphy.

Course Contents:

UNIT I:

Introduction to Molecular Modeling; What are models used for? Areas of application – Single molecule calculation, Assemblies of molecules; Reaction of the molecules; Drawbacks of mechanical models as compared to graphical models; Co-ordinate systems two – matrix, potential energy surface; Postulates of quantum mechanics, Electronic structure calculations, Ab initio, Semi-empirical and Density functional theory calculations, Molecular size versus accuracy; Approximate molecular orbital theories.

UNIT II:

Molecular Modeling by Homology, construction of frame work, selecting variable regions, Back bone and side chain placement and refinement, Optimization and validation of protein models. Threading and Ab-initio modeling, Ramchandran plot.

UNIT III:

Introduction to QSAR for lead module: Linear and nonlinear modeled equations, Biological activities, Physicochemical parameters and Molecular descriptors, Application of QSAR modeling in drug discovery.

UNIT IV:

Molecular Mechanisms: Introduction to Force field, Use of various parameters for force field calculation (Bond length, angle angle, torsion angle, Electrostatic interaction, Vander waals interactions, Miscellaneous interaction); Introduction Molecular Dynamics using simple models, Dynamics with continuous potentials, Constant temperature and constant dynamics, Conformation searching, Systematic search, Applications to protein folding.

UNIT V:

3D pharmacophores modeling, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies; 3D data base searching and virtual screening, Sources of data, molecular similarity and similarity searching, combinatorial libraries – generation and utility.

Course Learning Outcomes (CLOs):

CO1: Explain the various stages of drug discovery
CO2: Learn the concept of bioisosterism and drug resistance
CO3: Learn the concept of pharmacophore and modelling techniques
CO4: Explain the various techniques in Virtual Screening

Reference books:

(i) Molecular Modelling: Principles and applications byA. Leach

(ii) Molecular Modelling by Hans Peter, Heltje & Gerd Folkens, VCH

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

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

GENETIC ENGINEERING LAB **P**
Subject code: PLC BT 521 **2**

S. NO.	LIST OF EXPERIMENT
1.	Isolation of RNA and its estimation by orcinol method
2.	Isolation of plasmid DNA and its estimation by diphenylamine reaction
3.	Elution of plasmid DNA from agarose gel
4.	To perform restriction digestion of λ DNA
5.	Dephosphorylation of restriction enzyme digested vector pUC18
6.	To make bacterial cells competent for transformation

7. To perform of transformation of the desired bacterial strain with plasmid DNA

8. Screening of transformed colonies by X gal and IPTG

9. Verification of cloning by colony PCR and screening of the positive colonies

10. To perform a Southern Blotting for identification of desired DNA in a pool DNA samples

11. To perform ligation of λ EcoRI digest using T4DNA ligase

FERMENTATION BIOTECHNOLOGY LAB **P**
Subject code: PLCBT522 **2**

LIST OF EXPERIMENTS

1. Determine the growth patterns and specific growth rate of E. coli
2. Determine the effect of peptone concentration on *E .coli* growth
3. Fermentative production of Penicillin Antibiotics using *Penicilium chrysogenum*
4. To study the induction effect of β-galactosidase enzyme in *E. coli.*
5. Upstream and Downstream of bioprocess for the production of Citric acid by As spergillusniger.
6. Citric acid production from whey with glucose as supplementary carbon source by Spergillusniger.
7. Microbial production of citric acid by solid state fermentation process
8. Microbial production of enzymes by (a) solid state and (b) submerged fermentation.
9. Fermentative production of Ethanol using Saccharomyces cerevisiae

BIOINORMATICS –I (VIRTUAL LAB) **P**
Subject code: PLC BT 523 **2**

S.NO.	LIST OF EXPERIMENTS
1.	Retrieving sequence data from Entrez
2.	Locating the chromosome of a Gene
3.	Retrieve gene expression data from GEO
4.	Retrieving articles using PubMed
5.	Finding ORF of a Given Sequence
6.	Retrieving structural data of a protein using PDB database
7.	Retrieving Motif Information of a Protein Using Prosite

SEMESTER VI

Course Code: PCC BT 601 **Course Name**: Bioprocess Engineering II
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

To give students a solid foundation in biology and chemistry. To develop analytical and critical thinking skills in biological phenomena through scientific methods. Student will be prepared for understanding further **courses** related to **biochemical engineering**. Improvement in analytical skills.

Course Description:

This includes study of the **engineering** concepts for biological conversion of raw materials to food, pharmaceuticals, fuels, and chemicals.

Course Contents:

UNIT I: **Microbial growth and Media preparation:**
Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.

UNIT II: Sterilization:
Concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.

UNIT III: Ideal Reactor Operation:
Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemostate with immobilized cells, Chemostate with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors.

UNIT IV: Role of diffusion in Bioprocessing:
Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.

UNIT V: Bioreactor control mechanism:
Physical, Chemical and Biological environment of bioreactor, Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers and artificial neural network based Controllers. Basic concepts of computer modeling and optimization in bioprocess applications.

Course Learning Outcomes (CLOs):

CO1. Students will gain knowledge of bioreactor
CO2. Students will understand the application and functioning of bioreactors
CO3. This course will make the students to understand the downstream procedure and fermenter waste treatment

Text books:

(i) Principles of Microbe and cell cultivation- S. John Pirt, John Wiley & Sons
(ii) Bioprocess Engineering Principles by P. M. Doran, Academic Press
(iii) Hand Book Of Bioengineering- Skalak R &ShuChien, McGraw- Hill

Reference books:

(i) Biochemical Engineering Fundamentals by Bailey &Ollis, McGraw-Hill College Publishers
(ii) Chemical Engineering: An Introduction by Morton Denn, Cambridge University Press
(iii) Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press.

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

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

Course Code: PCC BT 602 **Course Name**: Plant Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The course is beneficial for students to have learning important milestones in the plant tissue culture. Understanding the concepts and principles of Plant tissue culture. Learning the techniques of sterilization and monitoring method of sterilization. Knowledge on environmental applications of genetic engineering through bioremediation.

Course Description:

The goal of this course is to introduce biotechnology methods in plants. The objective of the course is to give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.

Course Contents:

UNIT I:
Introductory history of plant biotechnology: Laboratory organization; Principles of Plant Tissue Culture. Concepts of totipotency, explants, inoculums, acclimatization. Nutrition of plant cells; Nutrient media: Composition of commonly used nutrient culture media with respect to their contents like inorganic chemicals, organic constituents. An appraisal of different media, selection of media, Sterilization of the media. Hormones: Auxins, Cytokinins, Gibberellins, Abscisic Acid, Ethylene etc. Explant preparation and Surface sterilization. Basic procedure for Aseptic Tissue transfer.

UNIT II:
Culture of plant materials- explants selection and technique of culturing. Organogenesis, Embryogenesis, Somaclonal variation, germiclonal variation. Establishment, growth and maintenance of Callus and cell suspension culture, Methods of sub culturing and transfer of regenerated plants to the field. Tissue and organ culture; Cellular differentiation and regulation of morphogenesis; Somatic embryogenesis; Control of organogenesis and embryogenesis; Single cell culture

UNIT III:
Haploid production: Androgenesis; Anther and microspore culture; Gynogenesis; Embryo culture and rescue in agricultural and horticultural corps; Protoplast isolation; Culture– regeneration; Somatic hybrid-cybrids; In vitro selection of mutants – mutants for salts, disease, cold, drought, herbicide and other stress conditions; Micropropagation: Application of micropropagation in agriculture and forestry. Meristem culture and virus elimination; Shoot tip culture.

UNIT IV:
Improved crop varieties through somaclonal variation in invitro cultures. Application of tissue culture for crop improvement in agriculture, horticulture and forestry. Cryopreservation and slow growth cultures, Freezing and storage, thawing, reculture. Application of plant tissue culture production of secondary metabolites and other industrial products.

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UNIT V:

Genetic transformation using Ti plasmid Manipulation of gene expression in plants; Production of marker free transgenic plants. Developing insect-resistance, disease- resistance, herbicide resistance plants. Genetic manipulation of flower pigmentation, developing quality of seed storage, Provitamin A, iron proteins in rice, modification of food plant taste and appearance, yield increase in plants.

Course Learning Outcomes (CLOs):

CO1. Students will learn the principals and technical advances behind the in vitro culture of plant cells and rDNA techniques

CO2. Students will learn the applications of plant transformation for improving the productivity and performance of plants under biotic and abiotic stresses

CO3. Students will understand the use of antisense technologies for improvement of crop plants

Text books:

(i) Hamish A, Collin & Sue Edwards: Plant Cell Culture, BIOS Scientific Publishers
(ii) Razdan M K: An Introduction to Plant Tissue Culture, Science Publishers

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

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

Course Code: PCC BT 603 **Course Name**: Bioinformatics II

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

Course Objective:

A student completing a major in Bioinformatics shall be able to apply: knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. existing software effectively to extract information from large databases and to use this information in computer modeling

Course Description:

This **course** provides an in-depth exploration of **bioinformatics** analysis of genomic data and the different approaches to mapping and aligning genome sequence data. You will also learn about programming and scripting along with techniques for the detection and analysis of genomic changes.

UNIT I:

Inference problems and techniques for molecular biology. Overview of key inference problems in biology: Homology identification, Genomic sequence annotation (Genes and ORFs identification), Protein structure prediction (Secondary and Tertiary structure prediction), Protein function prediction, Biological network identification, Next generation sequencing, Microarray data analysis

UNIT II:
Basics of RNA Structure prediction and its limitations, Features of RNA Secondary Structure, RNA structure prediction methods: Based on self- complementary regions in RNA sequence, Minimum free energy methods, Suboptimal structure prediction by MFOLD, Prediction based on finding most probable structure and Sequence co-variance method. Application of RNA structure modeling

UNIT III:
Machine learning: Decision tree induction, Artificial Neural Networks, Hidden Markov Models, Genetic Algorithms, Simulated Annealing, Support vector machines; The relation between statistics and machine learning; Evaluation of prediction methods: Parametric and Nonparametric tests, cross-validation and empirical significance testing (empirical cycle), Clustering (Hierarchical and K- mean).

UNIT IV:
Basic concept of Force field in molecular modeling (Potential energy calculation); Overview of key computational simulation techniques: Introduction to simulation, Computer simulation techniques, Types of computer simulation (Continuous, Discrete-event and Hybrid simulation), Differential equation solvers, Parameter estimation, and Sensitivity analysis.

UNIT V:
Overview of key techniques for the management of large document collections and the biological literature: Document clustering, Information retrieval system; Natural Language Processing: Introduction, Major areas of NLP, Natural language information extraction; Insilico Drug Designing: Major steps in Drug Designing, Ligand and Structure based drug designing, Protein-ligand docking, QSAR Modeling, Pharmacodynamics (Efficacy & Potency) &Pharmacokinetics
(ADME), Lipinski's rule of five, Pharmacogenomics

Course Contents:

Course Learning Outcomes (CLOs):

CO1. Students will be able to understand and describe and use the biological databases, perform structured query and analyze and discuss the results in biologically significant way.

CO2. Students will acquire knowledge of computer languages- PERL,C, SQL and JAVA and to write programs to solve biological problems

CO3. Students will be able to explain principle, algorithm and different methods of sequence alignments as well as execute alignments to address research problems

CO4. Students will become familiar with a wide variety of bioinformatics tools and softwares and apply these to conduct basic bioinformatics research and thus develop platform for molecular biology experiments

Text books:

(i) Computational Methods in Biotechnology – Salzberg S. L. et al., Elsevier Science

(ii) D.W.Mount; Bioinformatics- Sequence and genome analysis; Cold Spring HarbourLabpress

(iii) Protein Structure Prediction-A Practical Approach, MJE Sternberg, Oxford University Press.

(iv) Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag, NY.

Reference books:

(i) Purifing Protein for Proteomics, Richard J. Sinpson, I.K. International Pvt. Ltd.

(ii) Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co., 1997. 18/ 24

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

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

Course Code: DE BT 31 **Course Name**: Animal Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective: The application of biotechnology to animals will be examined. Challenges facing the intensive and extensive livestock industries, as well as wildlife management and conservation, will be discussed and debated in the context of biotechnologies that may be applied. Problems specific to horses and companion animals will be also considered. The contribution of biotechnology to laboratory animal models for human and animal disease will be addressed.

Course Description: The use of biotechnology for animal related issues such as food safety, disease control and biosecurity will be considered. A range of genetic, immunological and reproductive technologies will be introduced with some practical exposure. The integration of these technologies to improve animal production, health and welfare will be explored.

Course Contents:

UNIT I:
Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

UNIT II:
Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants

UNIT III:
Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins

UNIT IV:
Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring

UNIT V:
Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell

lineages and developmental control genes in drosophila and mice; Differentiation of germ layers; Cellular polarity; Stem cell differentiation; Blood cell formation; Fibroblasts and their differentiation; Differentiation of cancerous cells and role of protooncogenes

Course Learning Outcomes (CLOs):

CO1: Describe the limitations and challenges facing the animal industries and disciplines
CO2: Describe the various biotechnologies available to the animal related fields
CO3: Explain how developments in biotechnology may have applications in those fields
CO4: valuate and discuss public and ethical concerns over the use of animal biotechnology

Text books:

(i) B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell
(ii) G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO
(iii) I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International

Reference books:

(i) Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press
(ii) Animal cell culture: Ian Freshney

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

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

Course Code: DE BT 32 **Course Name**: Biomarker & Diagnostics

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

Course Objective: The objective of course domain requires the identification and the clinical validation of a huge number of **biomarkers** to predict disease **course**, to monitor disease evolution, to identify different sub-populations of patients, and to predict and monitor patient response to most of therapies

Course Description: This course Biomarkers and Diagnostics is designed to be a terminal degree with the graduate having strong prospects for immediate employment in industry.

Course Contents:

UNIT I:

Introduction to Molecular Diagnostics: History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario, Cellular Complexity: Cell components, Cell Differentiation, Cellular communication – endocrine signaling, paracrine signaling and autocrine signaling, contact dependent and synaptic communications, Intracellular networks – transport pathways, signaling pathways and metabolic networks. Eukaryotic Cell Control System and their Components, Intracellular cell cycle control system, Extracellular Cell Cycle Control System, Regulation of Cell Growth and Apoptosis, Genetic and epigenetic factors that regulate these pathways, their abnormalities that alter the pathways and cellular functions.

UNIT II:

Molecular Oncology Mitochondrial disorders: Cancer – Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing

UNIT III:

Biomarkers in disease diagnostics: FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour& cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders

UNIT IV:

Chromosomes, Human disorders, and Cytogenetic analysis: Structure, types and organization; Chromosome organization, Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Structural and Numerical aberrations and its consequences. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; function, and diseases. Uniparental disomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.

UNIT V:

Genomic instability, Chromosome mapping & Genome plasticity: Common fragile sites and methods of induction, Heritable fragile sites and FXS. Genomic Instability, mechanism and diseases. Trinucleotide Repeats; Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps, Relation to the probability of recombination, Pedigree analysis with genetic markers and overview of human genomProject

Course Learning Outcomes (CLOs):

CO1: To understand Biomarkers are used in research and clinical practice for:
CO2: Students will be able to diagnose diseases or predicting risks of disease,
CO3: Monitoring healthy people to detect early signs of disease,
CO4: Targeting specific groups of people for whom a particular drug may be useful,

Text books:

(i) Molecular biology of the cell. Bruce Alberts, 6th Edition
(ii) Principles of tissue engineering. Robert Lanza. Elsevier Publications
(iii) Introduction to Tissue engineering, applications and challenges. Ravi Birla.Wiley Publications

Reference books:

(i) Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
(ii) Cell and Molecular Biology: De Robertis EDP and De Robertis EMF
(iii) An introduction to Human Molecular Genetics by Pasternak et al., John Wiley & Sons

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

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

Course Code: DE BT 33 **Course Name**: Food Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The general aim of this subject is to provide the student with the transversal and specific capacities about the theoretical and practical aspects of the different biotechnological processes underlying the Food transformation, as well as those usually used by the food industry with the objective of improving production.

Course Description:

The main component of Food Biotechnology is food processing which refers to the phenomenon of changing the raw elements into edible food. To apprehend in simpler terms, Food Biotechnology involves the use of technology for efficient manufacturing, processing, treatment, preservation and distribution of food products.

Course Contents:

UNIT I:
History of Microorganisms in food: Historical Developments. Role and significance of microorganisms in foods. Intrinsic and Extrinsic parameters of foods that affect microbial growth. Basic principles of the equipment involved in the commercially important food processing methods and unit operations

UNIT II:
Microorganisms in food: spoilage of fresh meats and poultry, processed meats, seafood's, fruits and vegetables. Fermented food products, Medical foods, Probiotics and health benefits of fermented milk and foods products. Dehydrated Foods, Enteral Nutrient Solutions (Medical Foods), Single-Cell Protein. Starter cultures, Production process of cheeses, beer, wine and distilled spirits. Process of Brewing, malting, mashing, primary & secondary fermentation. Problems in food industry: catabolic repression, High gravity brewing, B-glucan problem, getting rid of diacetyl.

UNIT III:
Determining Microorganisms and/or their Products in Foods: Microbiological Examination of surfaces, Air Sampling, Metabolically Injured Organisms. Enumeration and Detection of Food-borne Organisms. Bioassay and related Methods. Common Food borne diseases. Nutritional boosts and flavor enhancers: Emerging processing and preservation technologies for milk and dairy products.

UNIT IV:
Food Preservation: Food preservation by various methods especially Irradiation, Characteristics of radiations in food preservation, principles underlying the destruction of microorganisms by Irradiation. Application of radiations in food (processing for irradiation). Radappertization, Radicidation, and Radurization of Foods. Effect of Irradiation on Food quality and storage ability. Miscellaneous Food

Preservation Methods: High- Pressure Processing, Pulsed Electric Fields, Aseptic Packaging, Mano thermosonication (Thermo-ultra-sonication).

UNIT V:

Indicators of Food Safety and Quality: Indicators of Food microbial quality, product quality and food safety. Fecal Indicator Organisms, Predictive Microbiology/Microbial Modeling. The Hazard Analysis Critical Control Point System (HACCP System), Microbiological Criteria. Food borne intoxicants and mycotoxins.

Course Learning Outcomes (CLOs):

CO1: Apply the scientific method to resolving problems.
CO2: Design experiments and interpret the **results**.
CO3 Develop individual **learning** strategies and planning and organization skills.

Text books:

(i) Frazier, W.S. and Weshoff, D.C., 2017. Food Microbiology, 5th Edn., McGraw Hill Book Co., New York.
(ii) Mann &Trusswell, 2007. Essentials of human nutrition.3rd edition. oxford university press

Reference books:

(i) Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, New Delhi
(ii) Lindsay, 1988. Applied Science Biotechnology.Challenges for the flavour and Food Industry.Willis Elsevier

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

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

Course Code: DE BT 34 **Course Name**: Entrepreneurship In Biotechnology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

The purpose of the course is that the students acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities, to develop the ability of analyzing. It also develops the students' ability of analyzing various aspects of entrepreneurship especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development and, finally, to contribute to their entrepreneurial and managerial potentials.

Course Description: Topics of this course include an overview of the global biotechnology industry, idea generation, business plan formulation, intellectual property protection, funding, personnel management including board composition, regulatory body interaction and company exits.

Course Contents:

UNIT I:
Entrepreneur - Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Development of Entrepreneurship steps in entrepreneurial process, Biotech Entrepreneurship in India, Identification of Business Opportunities, Qualities, skills and attributes that successful biotech entrepreneurs possess. Case studies of successful and unsuccessful bio-entrepreneurs

UNIT II:
Business development in biotechnology - Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources , project location, end product, quality issues, etc) Basic principles and practices of management - Definition, concepts and application; Organization types, coordination, control and decision making in management

UNIT III:
Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors. Marketing, Marketing research- concept and techniques, Considerations in establishment of biotechnological start-up - Different models of biotechnological start-ups. The budget for a biotechnological start-up company. Seed capital raising for a biotechnological startup company

UNIT IV:
Role of government and schemes, financial institutions in fostering Bio- entrepreneurship, Skills in bio-Entrepreneurship-Personality and attitude, Organizational behavior, Leadership, Principles of effective communication Body language, public speaking, presentations, business proposal writing.

UNIT V:
Biotechnology: emerging industries with examples from Transgenic, Environmental biotechnology, New drug development, DNA chip technology, Stem cell research, Tissue engineering. Contract Research

Organization, marketing consultancy, bio- learning module. Ethics and IPR in biotech-Industries - Fundamentals of ethics in business, Ethical dilemmas in biotech industry, IPR- Introduction, Forms of IPR.

Course Learning Outcomes (CLOs):

After the completion of the course, the students will be able to:
CO1. Have the ability to discern distinct entrepreneurial traits
CO2. Know the parameters to assess opportunities and constraints for new business ideas
CO3. Understand the systematic process to select and screen a business idea

Text books:

(i) Biotechnology Entrepreneurship1st Edition.Starting, Managing, and Leading Biotech Companies.CraigShimasaki. Academic Press.2014

(ii) Introduction to Biotech Entrepreneurship: From Idea to Business. A European Perspective. Matei**,** Florentina**,** Zirra, Daniela (Eds.).Springer nature publication.2019

Reference books:

(i) Biotechnology Entrepreneurship from Science to Solutions -- Start-Up, Company Formation and Organization, Team, Intellectual Property, Financing, Part 1st Edition. Michael L. Salgaller. Logos Press (August 25, 2010)

(ii) How to Start a Biotech Company. SourishSaha et.al., Independently published (September 4, 2019)

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

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

BIOPROCESS ENGINEERING II LAB **P**
Subject code: PLC BT 621 **2**

S. NO.	LIST OF EXPERIMENT
1.	Determine the growth patterns and specific growth rate of *E.coli*
2.	Determine the effect of peptone concentration on E.coli growth
3.	Determination of specific thermal death rate constant (Kd) for *E.Coli*
4.	Determine the effects of temperature & pH on Psuedomonasputida
5.	Upstream and Downstream of bioprocess for the production of Citric acid by spergillusniger
6.	Citric acid production from whey with glucose as supplementary carbon source by
7.	Upstream and Downstream of bioprocess for the production of α-amylase by spergillusniger Aspergillusnudulans
8.	Estimation of volumetric liquid mass transfer coefficient (KLa) using sodium sulphite method
9.	Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
10.	Computational Design of Fermentative Process for L-lysine production

PLANT BIOTECHNOLOGY LAB **P**
Subject code: PLC BT 622 **2**

S. NO.	LIST OF EXPERIMENT
1.	Preparation of Stocks solution for plant tissue culture media.
2.	Preparation of MS/B5 medium (semi-solid) and sterilization.
3.	Explant selection, preparation and surface sterilization.
4.	To learn culturing, sub culturing and maintenance using selected explants.
5.	Initiation of in vitro cultures through axillary bud induction.
6.	Initiation of callus cultures from different explants.
7.	Preparation of artificial seed/synthetic seed for conservation of germplasm.
8.	Extraction of DNA/RNA from plants and its estimation.
9.	Isolation and characterization of plant secondary metabolites from selected medicinal plants.
10.	Extraction of proteins from plants and its estimation.

BIOINFORMATICS II LAB **P**
Subject code: PLC BT 623 **2**

S. NO. LIST OF EXPERIMENT

1. Identification of Distantly related homologous sequences of a given query protein sequence using PSI-BLAST
2. Construct Phylogenetic tree of five evolutionary related protein/nucleotide sequences
3. Prediction of secondary structure of RNA using any web server.
4. Construction and analysis of Ramachandran Plot using any suitable web server
5. Align two homologous protein structure and calculation the RMSD for the superposition result
6. Comparative assessment of best available tools for genome annotation
7. Construction of restriction maps for various vectors used in genetic engineering using tool "NEB cutter".
8. Primer Design: Construct primers for the given DNA sequence using any suitable web based tool.
9. Generate 2D QSAR model of a set of legend descriptor data

Course Code: HSMC 401 **Course Name:**

Course Credit: 3 **Total Contact Hours:** 20hr

Course Objective(s):

- To disseminate knowledge on patents, patent regime in India and abroad andregistration aspects
- To make students aware about current trends in IPR and Govt. supports in promotingIPR
- To classify the role of regulatory committees in controlling the risk

Course Content:

Unit I:

Intellectual Property Rights: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies.

Unit II:

Biosafety-Regulatory Framework for GMOs in India & at International Level: Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBSC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment andForests Notification, (1989).

Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol.

Understand the legal steps involved in progressing a new drug to market. Grasping the current regulatory acts and safety norms of the modern pharmaceutical industries

Unit III:

Bioethics: Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.

Text Books/References*:*

Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management.India, IN: Cengage Learning India Private Limited.

Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learningPrivate Limited.

V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New AgeInternational publishers.

E-resources:

Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – AnOverview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

World Intellectual Property Organization. (2004). WIPO Intellectual PropertyHandbook. (https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf)

Course Outcomes:

CO1. The students shall get an adequate knowledge on patent and copyright. This providefurther way for developing their idea or innovations.

CO2. Identify the role of regulatory committees in controlling the risk.

CO3. Students should get enough information on ethical issues linked to research on animalmodels, transgenic, clinical trials.

CO4. Students to consider Intellectual Property (IP) as a career option as IP Counsel/Patent Examiner/Patent agent.

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

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