SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626115
(An Autonomous Institution
Affiliated to Anna University Chennai)

B.TECH. BIOTECHNOLOGY

REGULATIONS 2019

Estd : 1995

CURRICULUM AND SYLLABUS
(1st SEMESTER TO 8th SEMESTER)

(Applicable to candidates admitted from the Academic Year 2020 - 2021)

Approved in the Academic Council Meeting held on
25.09.2021

HEAD OF THE DEPARTMENT
Department of Biotechnology
Sethu Institute of Technology,
Pullor, Kariapatti-626 115

CHAIRMAN
ACADEMIC COUNCIL
Sethu Institute of Technology
Pulloor, Kariapatti - 625 115

DEPARTMENT OF BIOTECHNOLOGY

The Department of Biotechnology is established in the year 2020 to promote academic excellence in producing competent Biotechnologists. The B.Tech program has been approved by AICTE. The department has specialized faculty in the areas of Immunology, Bioprocess and Chemical Engineering, Genetic Engineering, Computational Biology and Nanobiotechnology. The students are trained to realize the need of Biotechnologists in the society and upgrade the recent advancements in the Biotechnology field.

VISION STATEMENT

- To achieve excellence in technical education and scientific research in the field of Biotechnology for the benefit of the society.

MISSION STATEMENT

- Providing quality technical education to enable the students to meet the industrial needs.
- Providing holistic learning environment to produce competent Biotechnologists.
- Enhancing professional skills towards employability and entrepreneurship in the field of Biotechnology.
- Fostering Industry Institute Interaction to upgrade recent technologies in the field of Biotechnology.
- Promoting scientific knowledge and creativity in research and development.
- Serving the society by imparting knowledge and providing solution in the field of Biotechnology.

PROGRAM EDUCATIONAL OBJECTIVES

1. Our graduates will practice as competent Biotechnologists by exhibiting the state of the art technical skills to cater to the needs of the Bio-industries. **[Core Competence]**

2. Our graduates will engage in research and sustained learning activities for solving real time problems in the society**. [Life-Long Learning]**

3. Our graduates will exhibit effective interpersonal skills in the industry and society. **[Professionalism]**

PROGRAM SPECIFIC OUTCOMES:

PSO-1 Our Engineering graduates will design solutions for complex engineering problems at the molecular level in the field of Genetic Engineering.

PSO-2 Our Engineering Graduates will design, perform and analyze the experiments using Bioreactors in the field of Bioprocess Engineering.

PSO -3 Our Engineering Graduates will design, model and analyze various computational methods using Bioinformatics databases to meet the industrial needs

PROGRAMME OUTCOMES:

The graduates of Biotechnology Program will have an ability to:

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals and Engineering specialization to the solution of complex engineering problems. **(Engineering knowledge)**

PO-2: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences. **(Problem Analysis)**

PO-3: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations. **(Design and Development of Solutions)**

PO-4: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. **(Conduct investigations of complex problems)**

PO-5: 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. **(Modern Engineering Tools)**.

PO-6: 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. **(Engineer and Society)**.

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. **(Environment and sustainability)**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **(Ethics)**

PO-9: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings. **(Individual and Team Work)**.

PO-10: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions. **(Communication)**.

PO-11: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments. **(Project Management and Finance)**

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change. **(Life-long learning)**

SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti - 626 115

(An Autonomous Institution)

B.Tech. Degree Programme

CHOICE BASED CREDIT SYSTEM

CURRICULUM

Regulation 2019

Bachelor of Technology in Biotechnology

OVERALL COURSE STRUCTURE

S.No.	Course Category	Total No. of Courses	Credits	Percentage
1	Humanities and Social Sciences (HS)	6	10	5.85%
2	Basic Science courses (BS)	9	27.5	16.08%
3	Engineering Science courses (ES)	7	17.5	10.23%
4	Professional Core courses (PC)	30	75	43.86%
5	Professional Elective (PE)	6	18	10.53%
6	Open Elective (OE)	4	12	7.02%
7	Project work (P)	4	11	6.43%
8	Mandatory Courses (MC)	5	--	--
TOTAL		71	171	100

COURSE CREDITS - SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
BT	23	20.5	22	23	23	23.5	22	14	171

SEMESTER I

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UEN101	English for Technical Communication (Common to ALL)	HS	2	0	0	2
2.	19UMA102	Engineering Mathematics – I (Common to ALL)	BS	3	1	0	4
3.	19UPH103	Engineering Physics (Common to ALL)	BS	3	0	0	3
4.	19UCY105	Applied Chemistry (Common to ECE, EEE, CSE, IT, BME & BT)	BS	3	0	0	3
5.	19UCS108	Problem Solving and PYTHON Programming (Common to ALL)	ES	3	0	0	3
6.	19UME109	Engineering Graphics (Common to ALL)	ES	3	1	0	4
PRACTICAL							
7.	19UCS110	Problem Solving and PYTHON Programming Laboratory (Common to ALL)	ES	0	0	3	1.5
8.	19UCS112	Engineering Fundamentals Lab (Common to ECE, CSE, IT, BME & BT)	ES	0	0	3	1.5
9.	19UGS113	Basic Sciences Laboratory (Common to ALL)	BS	0	0	2	1
MANDATORY							
10.	19UGM131	Induction Program (Common to ALL)	MC	0	0	2	P/F
			Total	17	2	10	23
Total Credits : 23							

SEMESTER II

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UEN201	Communication Skills for Professionals	HS	1	0	1	1.5
2.	19UMA207	Calculus, Complex Analysis and Transform Techniques (Common to AGRI, CHE, BME & BT)	BS	3	1	0	4
3.	19UPH204	Biomaterial Physics (BME & BT)	BS	3	0	0	3
4.	19UCY204	Environmental Science (Common to ALL)	HS	3	0	0	3
5.	19UBT205	Microbiology	ES	3	0	0	3
6.	19UBT206	Principles of Biochemistry	ES	3	0	0	3
PRACTICAL							
7.	19UGS210	Energy and Environmental Science Laboratory (Common to ALL)	BS	0	0	3	1.5
8.	19UBT211	Biochemistry Laboratory	ES	0	0	3	1.5
			Total	16	1	7	20.5
Total Credits : 20.5							

SEMESTER III

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UMA326	Transform Techniques and Partial Differential Equations (Common to AGRI, CHE, BME & BT)	BS	3	1	0	4
2.	19UBT302	Stoichiometry	PC	3	0	0	3
3.	19UBT303	Instrumental Methods of Analysis	PC	3	0	0	3
4.	19UBT304	Applied Thermodynamics for Biotechnologists	PC	3	0	0	3
5.	19UBT305	Principles of Genetics	PC	3	0	0	3
6.	19UBT306	Biochemical Metabolism	PC	3	0	0	3
PRACTICAL							
7.	19UBT307	Microbiology Laboratory	PC	0	0	3	1.5
8.	19UBT308	Instrumental Methods of Analysis Laboratory	PC	0	0	3	1.5
			Total	18	1	6	22
Total Credits : 22							

SEMESTER IV

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UMA424	Probability and Inferential Statistics	BS	3	1	0	4
2.	19UBT402	Cell Biology	PC	3	0	0	3
3.	19UBT403	Basic Industrial Biotechnology	PC	3	0	0	3
4.	19UBT404	Enzyme Engineering and Technology	PC	3	0	0	3
5.	19UBT405	Fluid Particle Mechanics & Mechanical Operations	PC	3	0	0	3
6.	19UBT406	Bioprocess Principles	PC	3	0	0	3
PRACTICAL							
7.	19UBT407	Cell Biology Laboratory	PC	0	0	3	1.5
8.	19UBT408	Fluid Particle Mechanics & Mechanical Operations Laboratory	PC	0	0	3	1.5
9.	19UBT409	Technical Seminar	P	0	0	2	1
MANDATORY							
10.	19UGM431	Gender Equality	MC	1	0	0	P/F
			Total	19	1	8	23
Total Credits : 23							

SEMESTER V

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UBT501	Molecular Biology	PC	3	0	0	3
2.	19UBT502	Bioprocess Engineering	PC	3	0	0	3
3.	19UBT503	Heat Transfer and Mass Transfer Operations	PC	3	0	0	3
4.	19UBT504	Protein Engineering	PC	3	0	0	3
5.	PE - I	Professional Elective – I	PE	3	0	0	3
6.	OE - I	Open Elective – I	OE	3	0	0	3
PRACTICAL							
7.	19UBT508	Molecular Biology Laboratory	PC	0	0	3	1.5
8.	19UBT509	Bioprocess Principles Laboratory	PC	0	0	3	1.5
9.	19UGM507	Creative Thinking and Innovation	P	0	0	2	1
10.	19UGS533	Interpersonal Skills Laboratory	HS	0	0	2	1
			Total	18	0	10	23
Total Credits : 23							

SEMESTER VI

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UBT601	Genetic Engineering	PC	3	0	0	3
2.	19UBT602	Genomics And Proteomics	PC	3	0	0	3
3.	19UBT603	Bioethics, IPR and Biosafety	PC	3	0	0	3
4.	PE – II	Professional Elective – II	PE	3	0	0	3
5.	PE – III	Professional Elective – III	PE	3	0	0	3
6.	OE – II	Open Elective – II	OE	3	0	0	3
PRACTICAL							
7.	19UBT608	Genetic Engineering Laboratory	PC	0	0	3	1.5
8.	19UBT609	Bioprocess Engineering Laboratory	PC	0	0	3	1.5
9.	19UGS631	Logical Reasoning and Aptitude	HS	1	0	0	1
10.	19UGS632	Soft skills and Communication Laboratory	HS	0	0	3	1.5
MANDATORY							
11.	19UGM632	Indian Constitution and Essence of Indian Traditional Knowledge (Common to BME, CSE, ECE, IT & BT)	MC	1	0	0	P/F
			Total	20	0	9	23.5
Total Credits : 23.5							

SEMESTER VII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	19UBT701	Downstream Processing	PC	3	0	0	3
2.	19UBT702	Immunology– Basics for Immunotechnology	PC	3	0	0	3
3.	19UBT703	Bioinformatics	PC	3	0	0	3
4.	PE – IV	Professional Elective – IV	PE	3	0	0	3
5.	PE – V	Professional Elective – V	PE	3	0	0	3
6.	OE – III	Open Elective – III	OE	3	0	0	3
PRACTICAL							
7.	19UBT707	Summer Internship	P	0	0	0	1
8.	19UBT708	Downstream Processing Laboratory	PC	0	0	3	1.5
9.	19UBT709	Immunology Laboratory	PC	0	0	3	1.5
MANDATORY							
10.	19UGM731	Professional Ethics and Human Values	MC	2	0	0	P/F
			Total	20	0	6	22
Total Credits : 22							

SEMESTER VIII

S.No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY							
1.	PE - VI	Professional Elective – VI	PE	3	0	0	3
2.	OE - IV	Open Elective – IV	OE	3	0	0	3
PRACTICAL							
3.	19UBT801	Project work	P	0	0	16	8
			Total	6	0	16	14
Total Credits : 14							

LIST OF ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBT901	Artificial Intelligence in Biotechnology	3	0	0	3
2.	19UBT902	Bioremediation Technology	3	0	0	3
3.	19UBT903	Biopharmaceutical Technology	3	0	0	3
4.	19UBT904	Principles of food processing	3	0	0	3
5.	19UBT905	Process Economics and Plant Design	3	0	0	3
6.	19UBT906	Molecular Pathogenesis of Infectious Diseases	3	0	0	3
7.	19UBT907	Stem Cell Technology in Healthcare	3	0	0	3
8.	19UBT908	Molecular Farming	3	0	0	3
9.	19UBT909	Marine Biotechnology	3	0	0	3
10.	19UBT910	Cancer Biology	3	0	0	3
11.	19UBT911	Biofuel	3	0	0	3
12.	19UBT912	Nano Medicine	3	0	0	3
13.	19UBT913	Therapeutic nutrition	3	0	0	3
14.	19UBT914	Fundamentals of Nanotechnology	3	0	0	3
15.	19UBT915	Vaccine Technology	3	0	0	3
16.	19UBT916	Bioreactor Engineering and Design	3	0	0	3
17.	19UBT917	Molecular Diagnostics	3	0	0	3
18.	19UBT918	Preclinical and Clinical Regulatory affairs	3	0	0	3
19.	19UBT919	Systems Biology	3	0	0	3
20.	19UBT920	Neurobiology and Cognitive Sciences	3	0	0	3
21.	19UBT921	Biochemical Toxicology and Degenerative Diseases	3	0	0	3
22.	19UBT922	Metabolic Engineering	3	0	0	3
23.	19UBT923	Environmental Biotechnology	3	0	0	3
24.	19UBT924	Biotechnology in Hazardous Waste Management	3	0	0	3
25.	19UBT925	Bioplastics	3	0	0	3

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	Course Category	L	T	P	C
1.	19UBT971	Herbal Medicines	OE	3	0	0	3
2.	19UBT972	Quality Assurance and Control In Food Industry	OE	3	0	0	3
3.	19UBT973	Food Packaging and System Development	OE	3	0	0	3
4.	19UBT974	Nanomedicine for Cancer Treatment	OE	3	0	0	3
5.	19UBT975	Patents and Copyright	OE	3	0	0	3

LIST OF ONE CREDIT COURSES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UBT861	Food microbiology and Fermentation laboratory	0	0	2	1
2.	19UBT862	Computational Reckoning of Bioprocess	0	0	2	1
3.	19UBT863	Automated Interactive Tools for Conformational Studies	0	0	2	1
4.	19UBT864	Environmental Engineering Laboratory	0	0	2	1
5.	19UBT865	3D Bio-printing of Living tissues	0	0	2	1
6.	19UBT866	Introduction to PERL Programming & Bio-Perl	0	0	2	1
7.	19UBT867	Bioentrepreneurship	0	0	2	1
8.	19UBT868	Regulation Perspective of Clinical Research	1	0	0	1
9.	19UBT869	Introduction to Fuzzy Logic and Genetic Algorithms	1	0	0	1
10.	19UBT870	Numerical methods for Biotechnologists	1	0	0	1

19UEN101	ENGLISH FOR TECHNICAL COMMUNICATION (Common to ALL Branches)	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To enhance the vocabulary of students.
- To strengthen the application of functional grammar and basic skills.
- To improve the language proficiency of students.

UNIT – I		**8**

Listening: Formal and informal conversations and comprehension – Speaking: introducing oneself – exchanging personal and social information – Reading: Skimming and Scanning – Writing: Sentence Formation, Formal Letters (Permission/Requisition) – Grammar: Parts of Speech – Tense Vocabulary Development: Technical Word Formation- Prefix – suffix – Synonyms and Antonyms Phrases and Clauses.

UNIT – II		**8**

Listening: Telephonic Conversations – Speaking: Pronunciation rules with Stress pattern – Reading: comprehension-pre-reading, post-reading – comprehension questions – Writing: Punctuation rules, paragraph writing – topic sentence – main ideas – free writing, short narrative descriptions, Precise writing, Developing Hints – Report Writing (Industrial, Accident) – Grammar: Voice – Vocabulary – Development: Words from other languages in English.

UNIT – III		**7**

Listening: Motivational speech by Great Speakers – Speaking: Narrating daily events – retelling short stories – Reading: Newspaper reading – Writing: Job application letter – Transformation of Information (Transcoding) – Grammar: Subject-Verb Agreement (Concord) – Vocabulary – Development: Same word in different parts of speech.

UNIT – IV		**7**

Listening: Understating the instruction – Speaking: Intonation and preparing dialogue on various formal and informal situation — Reading: Note Making from given text — Writing: Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) – Grammar: Spot the Errors in English – Vocabulary Development: One word substitution.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply grammar effectively in writing meaningful sentences and paragraphs.	Apply
CO2	Exhibit reading skills and comprehension to express the ideas in the given text.	Understand
CO3	Develop writing skills to present the ideas in various formal situations.	Create
CO4	Develop oral fluency to express the ideas in various formal situations.	Create
CO5	Exhibit writing skills to prepare reports for various purposes.	Create

TEXT BOOKS:

1. KN Shoba, Lourdes Joavani Rayen, Comsmunicative English, New Delhi, Cambridge University Press, 2017

REFERENCES:

1. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press, 2014.
2. Lakshminarayanan. K.R, English for Technical Communication, Chennai, ScitechPublications (India) Pvt. Ltd, 2004.
3. Rizvi. Asraf M, Effective Technical Communication, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2007.

19UMA102	ENGINEERING MATHEMATICS – I (Common to ALL Branches - Except CSBS)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases.
- To widen the students' knowledge base on linear algebra, growth rate computation andapplication of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions
- To apply these mathematical concepts (matrix theory, differentiation and integration) inengineering field.

UNIT – I	**MATRICES**	**8 + 3**

Eigen value and eigenvector of a real matrix — Characteristic equation — Properties — Cayley-Hamilton theorem (excluding Proof) – Orthogonal reduction – (transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT – II	**DIFFERENTIAL CALCULUS**	**9 + 3**

Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (n^{th} derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling – Heat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems).

UNIT – III	**FUNCTIONS OF SEVERAL VARIABLES**	**9 + 3**

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers.

UNIT – IV	**INTEGRAL CALCULUS**	**8 + 3**

Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.

UNIT – V	**MULTIPLE INTEGRALS**	**8 + 3**

Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integrationin Cartesian coordinates — Volume as triple integral.

SUPPLEMENT TOPIC (for internal evaluation only)	**3**

Evocation /Application of Mathematics, Quick Mathematics — Speed Multiplication and Division - Applications of Matrices.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the Characteristic Equation, Characteristic roots and use the applicability of Cayley – Hamilton theorem to find the Inverse of matrix.	Apply

CO2	Analyze functions using limits, continuity, derivatives and to solve Physical application problems.	Analyze
CO3	Apply differentiation techniques and Lagrange multiplier method to predict the extreme values of the functions with constrain.	Apply
CO4	Apply the concept of some special function like Gamma, Beta function and their relation to evaluate some definite integral.	Apply
CO5	Apply integration to compute Multiple integrals, Area and Volume in addition to change of order and change of variables.	Apply
CO6	Understand the basic concept in Matrix, Differentiation and Integration.	Understand

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications (p) Ltd, New Delhi, 8th Edition, 2011.
2. Veerarajan. T "Engineering Mathematics" Tata Mcgraw Hill Publishing Company, NewDelhi, 2008.
3. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 42nd Edition, 2012.

REFERENCES:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company,New Delhi, 11th Reprint, 2010.
2. Glyn James, "Advanced Engineering Mathematics", Pearson Education, New Delhi, 7thEdition, 2007.
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", Narosa PublishingHouse, New Delhi, 3rd Edition, 2007.
4. Bharati Krishna Tirthaji, "Vedic Mathematics - Mental Calculation", Motilal Banarsi DassPublications, New Delhi, 1st Edition, 1965.
5. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, New York, 10thEdition, 2011.
6. P.Sivaramakrishna Das, E.Rukmangadachari "Engineering Mathematics", Volume 1, Pearson Edison New Delhi, 2nd Edition, 2013.

19UPH103	ENGINEERING PHYSICS (Common to ALL Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the research interest in crystal physics.
- To use the principles of Lasers and its types.
- To apply principles of Quantum physics in engineering field.
- To develop knowledge on properties of materials.

UNIT – I	CRYSTAL STRUCTURE	12

Introduction – Classification of solids – Space lattice – Basis-Lattice parameter – Unit cell – Crystal system – Miller indices – d-spacing in cubic lattice – Calculation of number of atoms per unit cell –Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfection – Point defects – Line defects – Surface defects – Volume defects Burger vector.

UNIT – II	PHOTONICS	10

Introduction – Principles of Laser – Characteristics of laser – Spontaneous and stimulated emission – Population inversion – Einstein's A and B coefficients – Pumping methods – Basic components of Laser — Types of lasers — Nd-YAG laser — CO2 laser — Holography — Construction and Reconstruction of hologram – Industrial and Medical Applications.

UNIT – III	QUANTUM MECHANICS	13

Introduction — Black body radiation — Planck's law of radiation — Wien's displacement law —Rayleigh Jeans law – Compton Effect – Theory and experimental verification – Matter waves – Schrodinger's wave equation – Time dependent – Time independent equation – Particle in 1-D dimensional box

UNIT – IV	PROPERTIES OF SOLIDS	10

Introduction – Elasticity – Stress and Strain – Hooke's law – Three moduli of elasticity – stress- strain curve – Poisson's ratio – Factors affecting elasticity – Bending moment – Depression of a cantilever – Young's modulus by uniform bending – I-shaped girders.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Classify the types of crystals, lasers and elastic behavior of solids.	Understand
CO2	Apply the basic knowledge of crystal, quantum mechanics and mechanical behavior of solids to solve engineering problems.	Apply
CO3	Apply the principle of laser to estimate the wavelength of emitted photons.	Apply
CO4	Analyze the dual nature of matter using the concepts of quantum mechanics.	Analyze
CO5	Analyze the structural and optical properties of crystals in industrial and medical applications.	Analyze
CO6	Analyze the structural and optical properties of materials for specific Engineering Applications.	Analyze

TEXT BOOKS:

1. Dr. Mani.P, “Engineering Physics”, Dhanam Publications, Edition, 2018, Chennai.
2. Rajendran.V, “Engineering Physics”, Tata Mc-Graw Hill Publishing Company limited, NewDelhi, Revised Edition 2018.
3. Palanisami P.K., “Physics For Engineers”, Scitech Publications (India), Pvt Ltd., Chennai, 2018.

REFERENCES:

1. Raghuvenshi G.S., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2018.
2. Arul doss .G. “Engineering Physics”, PHI Learning Limited, New Delhi, Revised Edition2018.
3. Marikani. A., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2017.
4. Sankar B.N., and Pillai .S.O., “A Text book of Engineering Physics”, New Age InternationalPublishers Private Limited, New Delhi, Revised Edition 2017.
5. Avadhanulu M.N. and Kshirsagar P.G., “A Textbook: of Engineering Physics”, S.Chand &Company Ltd., New Delhi, 2018.

19UCY105	APPLIED CHEMISTRY (Common to ECE, EEE, CSE, IT, BME & BT)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain the knowledge on Chemical bonding and types.
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To know the importance of smart material and green chemistry.
- To acquire knowledge on energy storage devices.

UNIT – I	CHEMICAL BONDING	11

Chemical Bonding: Electronic Configuration – Ionic Bond – Covalent Bond – Metallic bond – Aufbau principle, Pauli Exclusion principle, Valence bond theory application and its limitations, Various types of hybridization (sp, sp^2,sp^3) (C_2H_2, C_2H_4, CH_4) – bond strength and bond energy – Hydrogen bonding, Vander Waals forces.

UNIT – II	WATER AND ITS TREATMENT TECHNOLOGIES	11

Hardness of water – types – expression of hardness (Problems) – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment Ion exchange process – Zeolite process – desalination of brackish water – Reverse Osmosis.

UNIT – III	SMART MATERIALS AND GREEN CHEMISTRY	11

Introduction to smart materials and their structure – Organic Light Emitting Diodes – Principles and applications, Liquid crystals – definition and applications. Green chemistry – Concept, importance, principles – e-waste disposal.

UNIT – IV	ENERGY STORAGE DEVICES	12

Batteries, fuel cells and super capacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell and application.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the basic concept of chemistry involved in chemical bonding, water treatment methods, smart materials, e-waste management and energy storage devices.	Understand
CO2	Apply the knowledge of chemical bonding to identify the types of bonds in molecules.	Apply
CO3	Analyze the impurities of water to find its hardness and remove the hardness causing substances.	Analyze
CO4	Explain the principles and application of organic light emitting diodes, liquid crystals and green chemistry.	Understand
CO5	Apply the knowledge of the basic electrochemical cell terminology to differentiate various types of energy storage devices.	Apply

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P)Ltd, New Delhi, 2002.
2. Dr.Sunita Rattan, “A Textbook of Engineering Chemistry” S.K. Kataria & Sons, New Delhi,2013.

REFERENCES:

1. Derek Pletcher and Frank C. Walsh, “Industrial Electrochemistry”, Chapman and Hall, NewYork, 1993.
2. Peter Grundler, “Chemical Sensors — An introduction for Scientists and Engineers”,Springer, New York, 2007.

19UCS108	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to ALL Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the concepts in problem solving for computing.
- To familiarize the logical constructs of programming.
- To illustrate programming in Python.

UNIT – I	INTRODUCTION	9

Definition and basic organization of computers – classification of computers – Software – Types of software – types of programming paradigms – Translators: compiler and interpreter – Problem solving tools: Algorithms – Flowchart – Pseudo code.

UNIT – II	INTRODUCTION TO PYTHON	9

Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function – conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve.

UNIT – III	CONTROL CONSTRUCTS	9

Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations.

UNIT – IV	FUNCTIONS AND PACKAGES	9

Functions – function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition – Anonymous or Lambda Function, recursion – packages.

UNIT – V	LISTS, TUPLES, DICTIONARIES AND STRINGS	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension – Strings: string slices; immutability, string functions and methods, string module.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Utilize problem solving tools in solving computing problems**.**	Apply
CO2	Solve mathematical expressions involving sequential logic in python.	Apply
CO3	Solve problems using python using decision structure and looping constructs**.**	Apply
CO4	Write modular programs using functions and packages**.**	Apply
CO5	Manipulate data using List, Tuples, Dictionaries and strings**.**	Apply

TEXT BOOKS:

1. Ashok Namdev Kamthane & Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018 (copyright)
2. Anurag Gupta & G P Biswas, “Python Programming — Problem solving, packages and libraries”, McGraw Hill Education, 2020 (copyright).

REFERENCES:

1. John V Guttag, “Introduction to Computation and Programming Using Python‘’, Revised andexpanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, “Exploring Pythonǁ, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programsǁ, CENGAGE Learning, 2012.
5. Charles Dierbach, “Introduction to Computer Science using Python: A ComputationalProblem Solving Focus”, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

19UME109	ENGINEERING GRAPHICS (Common to ALL Branches)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
- To impart knowledge in development of surfaces and isometric projections.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)	4

Importance of Graphics in Engineering Applications — Use of Drafting Instruments — BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning – Introduction to Plane Curves, Projection of Points, Lines and Plane Surfaces.

UNIT – I	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel,perpendicular and inclined to one of the plane.

UNIT – II	SECTION OF SOLIDS	10

Section of solids – simple position with cutting plane parallel, perpendicular and inclined to one of the plane.

UNIT – III	DEVELOPMENT OF SURFACES	10

Development of lateral surfaces of simple and truncated solids — Prisms, pyramids and cylinders and cones – Development of lateral surfaces of sectioned solids.

UNIT – IV	ISOMETRIC PROJECTIONS	12

Principles of isometric projection – isometric scale – isometric view – isometric projections of simplesolids and cut solids.

UNIT – V	ORTHOGRAPHIC PROJECTION	12

Representation of Three Dimensional objects – General principles of orthographic projection- Need for importance of multiple views and their placement – First angle projection – layout views – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the knowledge of First angle of projection to draw the projection ofdifferent simple solids.	Apply
CO2	Draw the section of solids with true shape of the section.	Apply
CO3	Draw the development of lateral surface of regular and sectioned solids.	Apply
CO4	Draw the isometric view of simple solids and sectioned solids.	Apply
CO5	Sketch the orthographic views from the given pictorial (isometric) view.	Apply

TEXT BOOKS:

1. Natarajan K.V., “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, (2006).
2. Bhatt N.D., “Engineering Drawing”, Charotar Publishing House, (2012).

REFERENCES:

1. Venugopal K., and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, (2008).
2. Gopalakrishnan K.R., “Engineering Drawing” (Vol.I&II), Subhas Publications. (2014).
3. DhananjayA.Jolhe, “Engineering Drawing with an introduction to Auto CAD”, Tata McGrawHill Publishing Company Limited, (2012).
4. Saravanan M, Benson Raj J and Ganesh Kumar S, “Engineering Graphics”, JBR TriseaPublishers, Nagercoil, (2020).

19UCS110	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY (Common to ALL Branches)	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To familiarize with programming environment.
- To familiarize the implementation of programs in Python.

LIST OF EXPERIMENTS:

Problems involve Sequential logic and Decision making:

1. Develop a computing solution to process the mark processing system (Record has the following fields: Name, Reg_no, Mark1, Mark2, Mark3, Mark4, Total, average). Generate student information with total and average marks.
2. Provide a software solution to compute the +2 Cutoff mark, given the Mathematics, physics and Chemistry marks. A college has decided to admit the students with a cut off marks of180. Decide whether the student is eligible to get an admission in that college or not.
3. A pizza in a circular shape with 8 inches and which is placed in a square box whose side length is 10 inches. Find how much of the box is “empty”?
4. A person owns an air conditioned sleeper bus with 35 seating capacity that routes between Chennai to Bangalore. He wishes to calculate whether the bus is running in profit or loss state based on the following scenario:

   Amount he spent for a day for diesel filling is: Rs. 15,000
   Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000
   Ticket amount for a Single person is Rs: 950
   If all the seats are filled, what would be the result? If
   only 15 seats are filled, what would be the result?
5. Consider the person ‘X’ has some amount in his hand and the person ‘Y’ has some amount in his hand. If they wish to exchange the amount among them, how they can exchange the amount by using the third party ‘Z’.

Problems involve iterations:

6. A man is blessed with a duck that can lay golden eggs. First day it lays one egg, in second day it lays two eggs, in third day it lays three eggs, and it continues to layeggs in an incremental manner day by day. Now calculate how many golden eggs thatduck lays till ‘n’th day.
7. Four People A,B,C,D are sitting in a Circular arrangement. In how many ways their seating can be arranged.
8. The Greek theater shown at the right has 30 seats in the first row of the center section. Each row behind the first row gains two additional seats. How many seats are in the 5th row in the center section?

Problem involve functions and recursive functions:

9. Develop a solution to identify the right angle triangle while giving the sides of a triangle. (Recall from the Pythagoras theorem that in a right triangle, the square of oneside equals the sum of the squares of other two sides)
10. A game has to be made from marbles of five colors, yellow, blue, green, red and Violet where five marbles has to be kept one upon another. Write a python program using recursion, to find how many ways these marbles can be arranged.
11. Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:

    Here is a high-level outline of how to move a tower from the starting pole, to the

goalpole, using an intermediate pole:

1. Move a tower of height-1 to an intermediate pole, using the final pole.
2. Move the remaining disk to the final pole.
3. Move the tower of height-1 from the intermediate pole to the final pole using original pole.

Problems involve List and Nested List:

12. In a class of 50 numbers of students, 6 students are selected for state cricket academy. Sports faculty of this school has to report to the state cricket academy about the selected students' physical fitness. Here is one of the physical measures of the selected students'; Height in cm is given for those 6 selected students [153,162,148,167,175,151]. By implementing functions, do the following operations.
    (i) State academy selector has to check whether the given height is present inthe selected students list or not.
    (ii) State academy selector has to order the height of students in an incremental manner.
    (iii) State academy selector has to identify the maximum height from the list.

Problems involve Dictionary and Tuples:

Dictionary:

13. A university wishes to create and maintain the details of the students such as Rollno, Regno, Name, Dept, Batch, Contact_no, Nativity (Indian/NRI) as key value pairs. Do the following operations:
    (i) Display the complete student details on giving Rollno as input.
    (ii) Display the complete student details whose nativity belongs to NRI.
    (iii) Display the complete student details whose department is CSE.

***Tuples*:**

14. A librarian wishes to maintain books details such as ISBN, Book Name, Author Name, Year published, Publisher Name. He wishes to retrieve the book details in the following scenario:
    (i) Retrieve the complete details of the book on giving ISBN.
    (ii) Retrieve the details of the book which published after the year 2015.
    (iii) Retrieve the details of the book whose author name is 'Andrew'.
    (iv) Retrieve the details of the book that name of the book is 'Python'

Problems involve Strings:

15. A musical album company has 'n' number of musical albums. The PRO of this company wishes to do following operations based on some scenarios:
    (i) Name of the album starts with 's' or 'S'.
    (ii) Name of the album which contains 'jay' as substring.
    (iii) Check whether the album name presents in the repository or not.
    (iv) Count number of vowels and consonants in the given album name.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Formulate algorithms for simple problems and translate the algorithms to a working program.	Apply
CO2	Formulate algorithms and programs for arithmetic computations and sequential logic.	Apply
CO3	Write iterative programs using control constructs.	Apply
CO4	Develop programs using functions, packages and use recursion to	Apply

	reduce redundancy.	
CO5	Represent data using lists, tuples, dictionaries and manipulate them through a program.	Apply

HARDWARE AND SOFTWARE REQUIRMENTS:

Hardware Requirements:

LAN SYSTEM WITH 30 NODES (OR) STANDALONE PCS – 30 NOS

Software Requirements:

OS – UNIX CLONE (License free Linux)

EDITOR – IDLE

19UCS112	ENGINEERING FUNDAMENTALS LABORATORY (Common to CSE, ECE,IT, BME & BT Branches)	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To familiarize the Hardware components of Computer
- To practice the installation of operating systems and other software's

LIST OF EXPERIMENTS:

GROUP A (COMPUTER) **24 Periods**

1. Demonstrating basic components of a personal computer
2. Assembling hardware components of a computer
3. Installation of windows and linux operating systems
4. Installation of software's both in windows and linux operating system
5. Configuring the computer to connect with internet
6. PC trouble shooting and maintenance

GROUP B (ELECTRICAL & ELECTRONICS) **21 Periods**

7. Study of electronic components and equipment's:
   (a) Resistor color coding
   (b) Measurement of AC signal parameter (peak to peak, RMS, period, frequency) using CRO
8. Study of logic gates
9. Soldering practice – components devices and circuits - using general purpose PCB
10. Characteristics of LED
11. Interfacing of PIR sensor with microcontroller
12. Switch control with microcontroller
13. Temperature measurement with microcontroller

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Identify the components of the computer and assemble the hardware components of a computer.	Apply
CO2	Install and uninstall the Operating systems and other software's both in in windows and Linux environment.	Apply
CO3	Demonstrate the basic network settings and make trouble shoot and Maintain the compute.	Apply
CO4	Demonstrate the function of electronics components.	Apply
CO5	Develop code for interfacing sensors with microcontroller.	Apply

HARDWARE AND SOFTWARE REQUIRMENTS:

Sl. No.	Name of the equipment / Software	Quantity required
1	LAN System with 30 Nodes (OR) Standalone PCs	30
2	OS – Unix Clone (License Free Linux)	-
3	Logic Trainer kit	2
4	CRO and AFO	2
5	Small Multipurpose PCBs	5
6	Soldering Guns	5

7	Multimeters	5
8	DC Ammeter	10
9	DC Voltmeter	10
10	Variable DC Power Supply	5
11	Node MCU Development Board	10
12	PIR Sensor (HC-SR501)	5
13	Temperature Sensor (LM35 OR DHT11)	5
14	PC with Windows 7	3
15	Logic Trainer kit	2

19UGS113	BASIC SCIENCES LABORATORY (Common to ALL Branches)	L	T	P	C
		0	0	2	1

PHYSICS LABORATORY

OBJECTIVES:

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival ofconclusions.
- To view and realize the theoretical knowledge acquired by the students throughexperiments.

LIST OF EXPERIMENTS:

A minimum of FIVE experiments shall be offered – 15 Periods

1. Laser – Determination of particle size and wavelength of Laser source using Diode Laser.
2. Ultrasonic Interferometer - Determination of velocity of sound in liquid and compressibilityof liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid.
4. Spectrometer – Determination of dispersive power of a prism.
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method — Determination of Young's modulus of the given rectangularbeam

CHEMISTRY LABORATORY

OBJECTIVES:

- To impart knowledge on basic concepts in applications of chemical analysis
- Train the students to handle various instruments.
- To acquire knowledge on the chemical analysis of various metal ions.

LIST OF EXPERIMENTS:

A minimum of FIVE experiments shall be offered – 15 Periods

1. Preparation of molar and normal solutions of the following substances — Oxalic acid,Sodium Carbonate, Sodium Hydroxide and Hydrochloric acid.
2. Conductometric Titration of strong acid with strong base
3. Conductometric Titration of Mixture of Acids.
4. Estimation of Iron by Potentiometry
5. Determination of Strength of given acid using pH metry.
6. Determination of molecular weight of polymer by Viscometry.
7. Comparison of the electrical conductivity of two samples - Conductometric method.
8. Estimation of copper in brass by EDTA method.

Laboratory classes on alternate weeks for Physics and Chemistry

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the principles of Optics, Laser physics and Elasticity to determine the Engineering properties of materials	Apply
CO2	Analyze the given liquid sample to determine the viscosity and compressibility of the liquid.	Analyze
CO3	Apply the principles of spectroscopy to determine the properties of materials	Apply
CO4	Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis.	Apply

CO5	Analyze the concentration of a given analyte by analytical methods.	Analyze
CO6	Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents.	Apply

19UGM131	INDUCTION PROGRAM (Common to ALL branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To rejuvenate the Body and Mind.
- To strengthen Attitude and soft skills.
- To practice Moral values of life.

UNIT – I	**PHYSICAL ACTIVITY**	**10**
Zumba - Bokwa Fitness – Yoga – Mediation – Fine Arts.		
UNIT – II	**CREATIVE ARTS**	**5**
Painting – Class Painting – Wall Painting – Art from waste.		
UNIT – III	**UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS**	**5**
Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence – Belief – Morality of life – Guest Lecture by Eminent personality.		
UNIT – IV	**LITERARY**	-
Elocution – Essay writing Competition – Impromptu Session – Dance and singing competition.		
UNIT – V	**PROFICIENCY MODULES**	**15**
Toastmaster club meet		
UNIT – VI	**INDUSTRIAL & LOCAL VISIT**	**8**
Vaigai Dam Theni – VOC- Port-Tuticorin – Madurai Radio City-Madurai – Alvin Milk Madurai – NSS Activities.		
UNIT – VII	**FAMILIARIZATION OF THE DEPT. AND INNOVATION**	**2**
Department Introduction and Purpose of Course – Eminent speakers – Scope and Feature of the Course – Latest Innovation.		

TOTAL: 45 PERIODS

(3 Weeks Model curriculum As per AICTE)

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Practice physical activities regularly.	Apply
CO2	Implement creativity in drawing and waste material.	Apply
CO3	Communicate their ideas effectively.	Apply
CO4	Identify inputs and outputs of different industry process.	Apply
CO5	Describe the scope and features of their programme of study.	Apply

REFERENCE:

1. Student Induction Programme: A Detailed Guide by AICTE, New Delhi.

19UEN201	COMMUNICATION SKILLS FOR PROFESSIONALS	L	T	P	C
		1	0	1	1.5

OBJECTIVES:

- Improve their oral expression and thought.
- Develop their confidence and ability to speak in public.
- Develop their capacity for leadership.

5 ORAL PROJECTS

Project – 1	**SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE (Time: 5 to 7 minutes)**

- To Speak in front of an audience with courage.
- Make your message clear, with supporting material.
- Create a strong opening and conclusion.

Project – 2	**SPEAK ON THE CHOSEN CONTENT (Time: 5 to 7 minutes)**

- Select a general topic and bring out specific purposes.
- Avoid using notes.
- Use symbolic ideas to develop your ideas.

Project – 3	**USE EFFECTIVE BODY LANGUAGE & INTONATION (Time: 5 to 7minutes)**

- Use appropriate posture, gestures, facial expressions and eye contact to express yourideas.
- Use proper intonation and adequate speech module.

Project – 4	**PRESENT YOUR TOPIC WITH VISUAL AIDS (Time: 5 to 7 minutes)**

- Persuade your points with suitable illustration, specific facts, examples
- Use suitable visual aids to present your topic with confidence.

Project – 5	**GRASP THE ATTENTION OF THE AUDIENCE (Time: 5 to 7 minutes)**

- Influence your listeners by adopting holistic viewpoint.
- Use emotions, stories, and positive quotes in your speech.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Communicate information ideas and opinions in any given situations	Create
CO2	Use language appropriately with clarity and fluency in any given circumstances	Create
CO3	Appraising the audience with clarity of thoughts with leadership quality	Create
CO4	Present the ideas creatively with coherence for given topic	Create
CO5	Evaluate the use of language to provide suggestions for correct usage	Create

TEXT BOOKS:

1. Competent Communication – A Practical Guide to becoming a better speaker, ToastmastersInternational, USA.
2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

Internal and External Assessment plan

<table>
<tr><th colspan="3">Internal Assessment plan</th><th colspan="3">External Assessment plan
Prepared speech based on the Toastmasters Projects (5-7 minutes)</th></tr>
<tr><th>S.No</th><th>Criteria</th><th>Marks</th><th>S.No</th><th>Criteria</th><th>Marks</th></tr>
<tr><td>1.</td><td>Submission of 5 Project scripts</td><td>5x2= 10 marks</td><td>1.</td><td>Confident, Eye Contact, Body Language</td><td>5 marks</td></tr>
<tr><td>2.</td><td>Prepared speech based on the Projects</td><td>5x5= 25 marks</td><td>2.</td><td>Content and clarity</td><td>20 marks</td></tr>
<tr><td rowspan="2">3.</td><td rowspan="2"><u>Performance in other Roles</u>
1.TMOD
2. Speech Evaluator
3. Table Topic Speaker and Master
4. General Evaluator
5.JIG and TAG Team member</td><td rowspan="2">5x3= 15 marks</td><td>3.</td><td>Command over Language</td><td>15 marks</td></tr>
<tr><td>4.</td><td>Error free language</td><td>10 marks</td></tr>
<tr><td></td><td>Total</td><td>50 marks</td><td></td><td>Total</td><td>50 marks</td></tr>
<tr><td colspan="6">Internal= 50 marks External= 50 marks Total=100 marks Minimum Pass Mark= 50 marks</td></tr>
</table>

19UMA207	CALCULUS, COMPLEX ANALYSIS AND TRANFORM TECHNIQUES (Common to CHEMICAL, AGRI, BME & BT)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.
- To acquaint the student with the concepts of analytic functions and their interesting properties which could be exploited in a few engineering areas, and be introduced to the host of conformal mappings with a few standard examples that have direct application.
- To make the student to acquire sound knowledge of Laplace transform techniques and its applications in getting the solution of certain linear differential equations.

UNIT – I	SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS	8 + 3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE (Bacterial growth, Population growth, Decayed problems).

UNIT – II	VECTOR CALCULUS	8 + 3

Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields –Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopiped.

UNIT – III	COMPLEX VARIABLES	8 + 3

Functions of a complex variable – Analytic function – Necessary and Sufficient Conditions (excluding Proofs) – Harmonic function – Properties of an analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping – Simple Transformations: w = z+c, cz, 1/z, and Bilinear transformation.

UNIT – IV	COMPLEX INTEGRATION	9 + 3

Statement and applications of Cauchy's integral theorem, Cauchy's integral formula and Cauchy Residue Theorem – Taylor's and Laurent's expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).

UNIT – V	LAPLACE TRANSFORM	9 + 3

Existence conditions – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function, impulse function and periodic function – Inverse Laplace transform – Convolution theorem (excluding Proof) – Solution of linear ODE of second order with constant coefficients.

SUPPLEMENT TOPIC (for internal evaluation only)	3

Evocation / Application of Mathematics.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the knowledge of higher order ordinary differential equations in real life engineering problems.	Apply
CO2	Apply the concept of vector identities in problem solving and evaluate the line, surface and volume integrals.	Apply
CO3	Apply the knowledge of standard techniques of complex variables and mapping for evaluating analytically.	Apply
CO4	Apply the knowledge of singularities, residues and applying in complex integration.	Apply
CO5	Apply the knowledge concept of Laplace transform and solve the problems with periodic function, convolution and Ordinary Differential Equation.	Apply
CO6	Understand the concept of particular integral, scalar potential, poles and periodic function.	Understand

TEXT BOOKS:

1. Veerarajan, T. “Engineering Mathematics” Tata McGraw Hill Publishing Company, NewDelhi, 2008.
2. Bali, N. P. and Manish Goyal, “Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, 2008.
3. Grewal, B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 43rdEdition, 2014.

REFERENCES:

1. Ramana, B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company,New Delhi, 11th Reprint, 2010.
2. Brown, J.W. and Churchil R.V.” Complex Variable and Applications” 7th Edition McGrawHill Publishing Company 2004.
3. Jain R.K and Iyengar S.R.K, “Advanced Engineering Mathematics”, Narosa PublishingHouse Pvt. Ltd., New Delhi, 3rd Edition, 2007.
4. Ince E.L “Ordinary Differential Equations”, Dover Publications 1958.

19UPH204	BIOMATERIAL PHYSICS (Common to BME & BT)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the fleet of scientific channels exploring the generation of high-tech Bio materials.
- To enable the students to understand the properties of Implant materials.
- To provide a comprehensive overview of new engineering material's in terms of thesynthesis, characterization, properties, and applications.

UNIT – I	BIO THERMODYNAMICS	13

Introduction – Thermodynamics of living systems – Conservation of energy in living systems – Entropy and Life – Gibbs and Standard free energy – Equilibrium constant – Coupled reactions – Diffusion – Laws of diffusion – Active transport – Facilitated diffusion – Osmosis – Osmoregulation – Viscosity and biological importance – Surface tension – Factors influencing surface tension – Biological importance.

UNIT – II	IMPLANT MATERIALS	10

Introduction – different classes of materials used in medicine – mechanical & thermal properties – Metallic implant materials – stainless steels – co-based alloys – Ti-based alloys – ceramic implant materials – aluminum oxides – glass ceramics – carbons – Applications.

UNIT – III	NEW ENGINEERING MATERIALS	12

Introduction – Metallic glasses – preparation – properties – medical applications – Shape memoryalloys – preparation – properties – medical applications – Bio Materials -- Classification – properties Testing of biomaterials – Application – Nano materials – fabrication methods – Plasma arching –Chemical Vapour deposition – ball milling – sol gel method – Medical applications – Nano medicine Nano sensors – Drug delivery.

UNIT – IV	FIBRE OPTICS IN MEDICINE	10

Introduction – Principle and propagation of optical fibre – Types of optical fibre – Attenuation – Advantages of optical fibre – Remote spectrophotometry – Fibre optic sensors – Body temperature and Blood pressure sensor – Applications – Fibre optic endoscope.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the law of thermodynamics in living system.	Apply
CO2	Interpret the usage of new engineering materials in the area of medical implantation.	Analyze
CO3	Explain the transport properties of biomolecules, mechanical and thermal properties of new engineering materials and the optical properties of fiber in the biotechnology field.	Understand
CO4	Analyze the constructional parameters of optical fibers in endoscopy imaging and various molecular transport phenomenon of biomaterials.	Analyze
CO5	Apply the concept of nanotechnology in biomaterials towards the	Apply

	usage of human body implantation.	
CO6	Apply the principle of propagation of light in optical fiber to study the various prospects in biomedical field.	Apply

TEXT BOOKS:

1. Jeffrey O.Hollinger, “An Introduction to biomaterials”, Second Edition, CRC Press. NewDelhi, 2010.
2. Dr. Mani.P ,“ Physics ”, Dhanam Publications, Chennai Revised Edition, 2018.
3. V. Rajendran, Materials Science, Tata McGraw-Hill, New Delhi, 2018.

REFERENCES:

1. Raghavan.V, “Material Science and Engineering”, Prentice Hall of India Private Limited,New Delhi, Revised Edition 2018.
2. Palanisamy P.K., “Engineering Physics’, Scitech Publication, Chennai, Edition, 2018.

19UCY204	ENVIRONMENTAL SCIENCE (Common to ALL Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of Environment and ecosystem.
- To acquire knowledge about the impact of environmental pollution.
- To understand the importance of environmental issues in the society.
- To gain knowledge about the impact of environment related to human health.
- To gain knowledge in alternative energies.

UNIT – I	ENVIRONMENT AND ECOSYSTEMS	9

Definition, scope and importance of environment – Need for public awareness – Concept of ecosystem – Structure and function of ecosystem – Producers, consumers and decomposers – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grass land ecosystem.

UNIT – II	ENVIRONMENTAL POLLUTION	9

Definition — Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution – pollution case studies – Role of an individual in prevention of pollution – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – III	SOCIAL ISSUES AND THE ENVIRONMENT	9

Water conservation, rain water harvesting, watershed management — Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).

UNIT – IV	HUMAN POPULATION AND THE ENVIRONMENT	9

Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights – Value education – HIV /AIDS – Women and child welfare – Role of information technology in environment and human health.

UNIT – V	FUTURE POLICY AND ALTERNATIVES	9

Introduction to future policy and alternatives – fossil fuels – nuclear energy-solar energy – wind energy – hydroelectric energy – geothermal energy – tidal energy – sustainability – green power –nanotechnology.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the basic concept of structure and function of ecosystem	Understand
CO2	Apply the knowledge of various pollution types to prevent the ecosystem and Environment	Apply
CO3	Analyze the environmental problem to report the social issues and the environment.	Analyze
CO4	Compare the suitable methods for conservation and sustainable development of natural resources	Analyze
CO5	Apply the principles of value education with respect to human	Apply

	population to preserve environment	
CO6	Analyze the current energy crisis and suggest a suitable sustainable alternative that promotes social health and environmental prospects.	Analyze

TEXT BOOKS:

1. Anubha Kaushik, kaushik C.P., “Environmental Science and Engineering”, Third Edition,New Age International, New Delhi, 2009.
2. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

REFERENCES:

1. Gilbert M. Masters, ‘Introduction to Environmental Engineering and Science’, PearsonEducation, Upper saddle River, New Jersey, 2008.
2. Miller T.G. Jr., Environmental Science”, Wadsworth Publishing Company, Belmont, California, 2005.
3. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd., New Delhi, 2001.
4. Trivedi R.K., Goel P.K., “Introduction to Air Pollution”, Techno-Science Publication, Jaipur,2005.

19UBT205	MICROBIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the microbial world and their nutritional requirements for growth and metabolism
- Conceptualize the principle, classifications and the characteristics of microbial species and study its applications in industrial and environmental sector.

UNIT – 1	INTRODUCTION TO MICROBIOLOGY AND MICROSCOPY	9

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms - Microscopic examination of microorganisms: Bright field light Microscopy, Compound, Phase Contrast, Fluorescence and Electron microscopy - Principles of different staining techniques like gram staining, acid fast, negative staining, capsular staining, flagellar staining, endospore staining.

UNIT – 2	MICROBES- STRUCTURE AND MULTIPLICATION	9

Microbial morphology: Structure and Functional anatomy of Prokaryotic and Eukaryotic Cells - Multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages

UNIT – 3	MICROBIAL NUTRITION, GROWTH AND METABOLISM	9

Common nutritional requirements of bacteria - major, minor, trace selements and supplements, Nutritional types : Autotroph, Heterotroph, Chemotroph and Lithotroph - Different media used for bacterial culture based on physical state, chemical composition and functional type, Batch growth - Growth curve, kinetics – doubling time, growth rate, quantification of growth - direct and indirect methods – Introduction to continuous culture - Microbial metabolism: Entner–Doudoroff pathway, Aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT – 4	CONTROL OF MICROORGANISMS	9

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, antifungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms such as *Staphylococcus aureus* and Pseudomonas species. Case Study- Antibiotic sensitivity assay (*Staphylococcus aureus*)

UNIT – 5	INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY	9

Primary metabolites; secondary metabolites and their applications; preservation of food; production of penicillin, alcohol, vitamin B-12; biogas; bioremediation; bioleaching; biofertilizers and biopesticides; microorganisms and pollution control; biosensors and biofilters

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Ability to define, understand and explain the fundamentals of microbial species, their taxonomical classification, cell structure and metabolism.	Understand
CO2	Ability to apply and evaluate the antibiotics and antifungal agents to control the microbial species	Apply

CO3	Ability to analyze fundamental concepts in the structure and functioning of a microbial cell	Analysis
CO4	Ability to investigate biochemical aspects of various microbes	Evaluate
CO5	Ability to conduct experiments in laboratories and participate in solving societal issues with the help of microbes.	Modern Tool Usage

TEXT BOOKS:

1. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 2005.
2. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Prescott L.M., Harley J.P., Klein DA, Microbiology, McGraw Hill , USA, 2005.

REFERENCES:

1. Talaro, K. P., & Chess, B. (2018). Foundations in microbiology. McGraw-Hill.
2. Lim D, “Microbiology”, Second Edition, WCB-McGraw Hill, 2001.
3. Remaut, H., & Waksman, G. (2004). Structural biology of bacterial pathogenesis. Current opinion in structural biology, 14(2), 161-170.

19UBT206	PRINCIPLES OF BIOCHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the scientific essentials of basic structure and functions of biomolecules
- Explore the principle, classifications and the characteristics of different biomolecules and study its biotechnology applications in healthcare sector.

UNIT – 1	BIOCHEMICAL ORGANIZATION	9

Living systems - basics, chemical composition, structure and reactivity of simple biological molecules, chemistry of water and its relevance to living systems, acids, bases, pH and buffers in biological systems - Scope of clinical biochemistry, component of the cell - structure and biochemical functions - membrane structure and functions, transport through biological cell membrane

UNIT – 2	STRUCTURE AND FUNCTION OF CARBOHYDRATES AND LIPIDS	9

Carbohydrates:mono, di, oligo&polysaccharides - Proteoglycans - Glucosaminoglycans – Mutarotation, Functions of carbohydrates - Reactions of monosaccharides - Lipids: fattyacids, glycerol- Simple lipids: fats, oils and waxes- Complex lipids: phospholipids, glycolipids, sphingolipids- Derivedlipids: steroids, terpenoids and carotenoids - Functions of lipids -saponification, iodination and hydrogenation

UNIT – 3	STRUCTURE AND FUNCTION OF PROTEINS AND NUCLEIC ACIDS	9

Proteins: Amino acids, peptides - hierarchy of organization: primary, secondary, tertiary and quaternary structures - conjugated proteins: glycoproteins, proteoglycans and lipoproteins - Functions of Proteins - Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, structure and function of RNA and DNA, nucleoprotein complexes.

UNIT – 4	ENZYMES AND ENZYME KINETICS	9

Nomenclature- classification- introduction to biocatalysts: activation energy, specificity, factors influencing enzyme activity, Briggs Haldane equation, Michaelis - Menten equation- LB Plot -Types of enzyme inhibition.

UNIT – 5	INTERMEDIARY METABOLISM AND REGULATION	9

Overview of metabolism - Glycolysis- TCA cycle- gluconeogenesis- pentose phosphate shunt- glyoxalate shunt - amino acid metabolism: deamination, transamination and decarboxylation, urea cycle- interconnection of pathways and metabolic regulation – Bioenergetics and ATP

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Ability to define, understand and explain the fundamentals of living things, their classification, cell structure and biochemical organization.	Understand
CO2	Ability to apply the principle of biomolecules and their characteristics in biochemical processes	Apply

CO3	Ability to analyze biochemical processes involved in the metabolic pathways of biomolecules	Analysis
CO4	Ability to investigate enzyme catalyzed metabolic reactions and their regulation.	Evaluate
CO5	Ability to conduct experiments in laboratories and participate in solving clinical problems with strong foundation in the structure and reactions of Biomolecules	Modern Tool Usage

TEXT BOOKS:

4. Nelson D. L. and Cox M. M., “Lehninger’s Principles of Biochemistry”, 7th Edition. Macmillan Publisher,2017.
5. Moran L. A., Horton R.A., Scrimgeour G., Perry M., Rawn D., “Principles of Biochemistry” 5th Edition,Pearson New international Edition,2014.
6. McKee T. and McKee J. R., “Biochemistry- The Molecular Basis of Life”, Oxford University Press, London, 2008.
7. Devlin, T. M. (2011). Textbook of Biochemistry. 6th edition. John Wilelly &Sons

REFERENCES:

4. Sathyanarayana. U and Chakrapani U (2013). Biochemistry, 3rd edition, Elsevier
5. Berg J. M., Tymoczko J. L. and LubertStryer, “Biochemistry”, W H Freeman and Company, New York, 2002.
6. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P., “Harpers Illustrated Biochemistry”McGrawHill, 31th Edition 2018.

19UBT211	BIOCHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Learn and understand the principles behind the qualitative and quantitative analysis of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.
- Demonstrate various methods to quantity the biomolecules and measuring enzymatic activity using spectroscopic methods

LIST OF EXPERIMENTS:

1. General guidelines for working in biochemistry lab (theory)
2. Demonstration of use of volume and weight measurements devices
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Estimation of starch by Anthrone method.
7. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid
8. Qualitative analysis for Proteins
9. Protein estimation by Biuret and Lowry's methods.
10. Determination of cholesterol by Zak's method.
11. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect.
12. Enzymatic assay: phosphatase from potato.
13. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Demonstrate various qualitative analysis of biomolecules in given samples	Apply
CO2	Examine biochemical normal and abnormal reactions in human body and estimate the glucose and cholesterol.	Analyze
CO3	Evaluate the total amount of carbohydrates, proteins and lipids in the given samples by conducting suitable experiments.	Evaluate

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	1
2	Colorimeter	2
3	Autoclave	1
4	Hot air Oven	1
5	Incubators	2
6	Light Microscopes	4
7	Laminar Flow Chamber	2

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.

2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCES

1. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Connecticut.

2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers.

19UGS210	ENERGY AND ENVIRONMENTAL SCIENCE LABORATORY (Common to ALL Branches)	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To analyze the Band gap, moment of inertia, thermal conductivity and rigidity modulus ofthe materials.
- To gain knowledge in Photonics.

LIST OF EXPERIMENTS:

A minimum of FIVE experiments shall be offered

1. Determination of Energy band gap of a semiconductor.
2. Torsion pendulum — Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.
3. Spectrometer - Determination of wavelength of mercury spectrum using grating.
4. Laser – Determination of numerical aperture and acceptance angle of an optical fiber.
5. Newton's rings – Determination of radius of curvature of a convex lens.
6. Lee's Disc - Determination of thermal conductivity of a bad conductor.
7. Determination of Solar cell Characteristics using optical transducers kit.

CHEMISTRY LABORATORY

OBJECTIVES:

- To apply the theoretical concepts to perform lab experiments.
- To assess the water quality parameters.
- To acquire knowledge on water quality parameters for the analysis of industrial effluents

LIST OF EXPERIMENTS:

A minimum of FIVE experiments shall be offered

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of Chloride in water sample (Argentometric method).
4. Determination of DO in water.
5. Estimation of chromium in tannery wastes.
6. Estimation of available chlorine in bleaching powder.
7. Estimation of iron by Spectrophotometry.
8. Determination of acidity of industrial effluents.

Laboratory classes on alternate weeks for Physics and Chemistry

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the principles of Light and Elasticity to determine the Engineering properties of materials	Apply
CO2	Analyze the thermal conductivities of different bad conductors	Analyze
CO3	Analyze the Characteristics of a semiconductor	Analyze

CO4	Apply the basic knowledge of water quality testing for environmental sustainability.	Apply
CO5	Analyze the water quality parameters for industrial effluents to prevent water pollution.	Analyze
CO6	Estimate the quality of water that suits for domestic and industrial applications	Apply

19UMA326	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS (Common to AGRI, CHEMICAL, BME & BT)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To make the student knowledgeable in formulating certain practical problems in terms of partial differential equations, solve them and physically interpret the results.
- To familiarize the students to formulate and identify certain boundary value problems encountered in engineering practices, decide on applicability of the Fourier series method of solution, solve them numerically and interpret the results.
- To acquaint the student with the basics of Z - transform in its applicability to discretely varying functions, gained the skill to formulate certain problems in terms of difference equations and solve them using the Z - transform technique bringing out the elegance of the procedure involved.

UNIT – I	FOURIER SERIES	9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic analysis – Application of Fourier series – Gibb's Phenomenon.

UNIT – II	FOURIER TRANSFORM	9 + 3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties — Transforms of simple functions — Convolution theorem — Parseval's identity — Application of Fourier Transform.

UNIT – III	Z-TRANSFORM AND DIFFERENCE EQUATIONS	9 + 3

Organization of nervous system – Neuron – Classification and Properties of nerve fibers – Synapse – Neurotransmitters – Reflex activity – Central Nervous System (CNS): Structure and functions of Brain and Spinal cord – Peripheral Nervous System (PNS): Structure and functions of Sympatheticand Parasympathetic nervous system.

UNIT – IV	PARTIAL DIFFERENTIAL EQUATIONS	9 + 3

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non- homogeneous types.

UNIT – V	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	9 + 3

Introduction of Partial differential equations – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems.	Apply
CO2	Apply the knowledge of Fourier transform and its properties which are used to transform signals between time and frequency domain.	Apply

CO3	Apply the acquired knowledge of Z transform and its properties inverse Z transform and difference equations.	Apply
CO4	Apply the knowledge of partial differential equation in solving linear and higher order partial differential equation.	Apply
CO5	Apply the knowledge of PDE in solving linear, higher order and one dimensional Wave, Heat flow equation.	Apply
CO6	Understand the basic concept of periodic, non-periodic function and nature of partial differential equation.	Understand

TEXT BOOKS:

1. Grewal B.S, “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 42nd Edition, (2012).
2. Bali N.P., Manish Goyal and Watains, “Advanced Engineering Mathematics”, Firewall Media(An imprint of Laxmi Publication Private limited) New Delhi, 7th Edition, 2009.
3. Veerajan.T, “Higher Engineering Mathematics”, Yes Dee Publishing Pvt. Limited, 2015.

REFERENCES:

1. Kandasamy.P, Thilagavathy.K and Gunavathy.K, “Engineering Mathematics III”, S.Chand &Company Ltd., New Delhi, 3rd Edition, 1996.
2. Ramana.B.V, “Higher Engineering Mathematics” Tata McGraw Hill, New Delhi, 11th Reprint2010.
3. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi,3rd Edition, 2007.
4. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India, 10th Edition, 2011.

19UBT302	STOICHIOMETRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn various systems of units and dimensions pertaining to unit operations and unit processes.
- Calculate the amount of a particular substance produced or used in a chemical reaction.
- Explain material and energy balance for various reaction systems.

UNIT – 1	BASIC CHEMICAL CALCULATIONS	9

Introduction to process calculation - Dimensions and systems of units - Fundamental and Derived quantities - Unit conversions in FPS, MKS and SI systems - Moles, density and composition – Composition of mixtures and solutions – Mass fraction, Mole fraction, Mass ratios, Molarity, Molality, Normality, ppm, Percentage, Composition by density

UNIT – 2	IDEAL GASES AND VAPOUR PRESSURE	9

Behaviour of ideal gases – Kinetic theory of gases - Application of ideal gas law – Gaseous mixtures – Partial pressures, Partial volumes, Volume changes with change in composition - Vapour pressure - Effect of Temperature on vapour pressure - Vapour pressure plots – Vapour pressure of immiscible liquids – Solutions - Air-water vapour systems – Humidity - Molar Humidity - Relative Humidity - % Saturation - Humid Volume – Humidity chart – Wet, Dry bulb - Dew point temperatures.

UNIT – 3	MATERIAL BALANCE WITHOUT CHEMICAL REACTIONS	9

Introductory Concepts - Simplification of the general mass balance equation for steady and unsteady state processes - Procedure for material balance calculations - Calculation for unit operations at steady state condition - Drying, Distillation, Absorption, Mixing, Crystallization, Evaporation - Recycling and by passing operations.

UNIT – 4	MATERIAL BALANCE INVOLVING CHEMICAL REACTIONS	9

Basic concepts - Limiting reactant - Excess reactant - Conversion, Yield and Selectivity - Simple problems - Material balances involving combustion - Reactions, Recycle and purge operations with chemical reaction.

UNIT – 5	ENERGY BALANCE	9

General energy balance equation for open and closed systems-Heat capacity calculations - solids, liquids and gases, gas mixture and liquid mixture - Mean heat capacity of gases - Sensible heat and latent heat of fusion – Sublimation – Vaporization - The Standard heat (Enthalpy) of formation - Standard heat of combustion - Calculation of standard heat of reaction.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Understand basic concepts of process calculations, ideal gases, vapour pressure, material and energy balances.	Understand
CO2	Perform calculations pertaining to basic processes and operations.	Apply
CO3	Examine the behaviour of ideal gas and properties of gas-vapour mixture. Study material and energy balance for a given system and	Analysis

	recycling operations.	
CO4	Estimate the criteria like temperatures, pressures, mass etc., involved in a controlled process. Balance the operations at material and energy level for the efficient bioprocess	Evaluate
CO5	Apply the concept of basic process calculations, energy balance and material balance in design of reactors and in biochemical processes.	Implement

TEXT BOOKS

1. Narayanan, K.V., Lakshmikutty B., “Stoichiometry and Process Calculations”, Prentice Hall International, 1st Edition, 2011.
2. D.C.Sikdar,”Chemical process calculations “Prentice Hall India Learning Private Limited, 2013.

REFERENCES:

1. McCabe W.L & J.C.Sonith & P.Harriot “Unit operations of chemical Engineering” 6thEdn McGraw Hill 2001.
2. Himmelblau, D.M. “Basic principles and calculations in Chemical Engineering”, 8thEdition, PHI, 2011.
3. Robert W.Fox, Alan T.McDonald & Philip J.Pritchard “Introduction to Fluid Mechanics” 7th edn John Wiley & Sons 2009.
4. Bhatt B.I & SB Thakore, Stoichiometry - Fifth edition Tata McGraw Hill 2012.

19UBT303	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn all aspects of providing analytical results by understanding principles and instrument.
- Acquire knowledge and ways to handle various spectroscopic methods, electro analytical techniques, chromatographic techniques.

UNIT – 1	GENERAL INTRODUCTION	9

Instrumental methods of analysis – Classification – Advantages an Limitations - sensitivity and detection limits - Calibration of instruments - Precision, Accuracy, Sensitivity, Selectivity, LOD, LOQ, Dynamic Range - Introduction of signals - Types of errors - Signal to noise ratio - Signal to noise enhancement - Definition and types of samples - Sampling plan - Correlation between quality of sample and its analysis - Sampling method - Solids, Liquids and Gases.

UNIT – 2	SPECTROSCOPIC METHODS OF ANALYSIS	9

Principle – Instrumentation - Analytical applications and limitations - UV, IR, NMR, MS, AAS – Fluorescence – XRD - Nephelometry.

UNIT – 3	ELECTRO ANALYTICAL TECHNIQUES	9

Voltametry - Cyclic and Pulse voltammetry – Applications – Coulometry – Principle and applications – Electrophoresis - Zone electrophoresis – AGE – PAGE – Zymography - Supporting media - Technique of electrophoresis - Capillary electrophoresis - Electro osmotic flow techniques – Isoelectric Focusing - Instrumentation - Detection.

UNIT – 4	SEPARATORY TECHNIQUES	9

Chromatography – Introduction – Theory - Types and Applications - Paper chromatography – TLC - Column chromatography - Gel permeation chromatography - Affinity chromatography - Ion exchange chromatography - High performance liquid chromatography.

UNIT – 5	MODERN ANALYTICAL TECHNIQUES	9

UPLC - LC-MS – HRMS – Radio analytical methods - Neutron activation analysis - Isotope dilution analysis - Particle induced X-ray Emission - Use of radioisotopes - In industry, agriculture and physicochemical studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Explain the fundamentals of instrumental analysis, components of instruments and sampling.	Understand
CO2	Use the analytical techniques to separate and facilitate sample analysis	Apply
CO3	Solve the problems by analysing and evaluating the complex compounds using spectroscopic and electrochemical techniques.	Analysis
CO4	Separate, purify and study the characteristics of compounds under examination.	Examine
CO5	Use modern analytical techniques for their bio-product characterization.	Modern Tool Usage

TEXT BOOKS:

8. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”.Cengage Learning , 2007
9. Instrumental methods of analysis by Willard, Merit Dean and Settle Edition 1986. CBS publishers and distributors

REFERENCES:

1. Wilson K., Walker J., “Principles and Techniques of Biochemistry and Molecular Biology”, Cambridge University Press, 7th Edition, 2010.
2. Robert D.B., “Introduction to Instrumental Analysis”, McGraw Hill, 1st Edition, 1986.
3. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, Vth Edition, McGraw-Hill, 1985
4. Sharma, B.K. “Instrumental Methods of Chemical Analysis: Analytical Chemistry” Goel Publishing House, 1972

19UBT304	APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Apply thermodynamic principles to reach solution of various equilibrium problems and energy flows in biotechnology.

UNIT – 1	FUNDAMENTALS OF THERMODYNAMICS	9

Heat and Temperature – Internal energy and enthalpy - Extensive and intensive properties - Differentials in Thermodynamics - State and Path Functions - Cycle Reversibility Quasi - Static Process - Irreversible Process - Zeroth law of thermodynamics - First law of thermodynamics - Law analysis for closed system (non-flow process) - Constant-V and Constant-P processes - Steady flow energy equation - Boilers, Condensers, Turbines.

UNIT – 2	VOLUMETRIC PROPERTIES OF FLUIDS	9

Properties of fluids exhibiting ideal behaviour and its process calculations - Estimation of properties using virial equations of state - Application of the virial equations - Introduction to cubic equations of state - Van der Waals Equation - Virial Equation – Redlich – Kwong Equation - Theorem of corresponding states - Acentric factor - PVT behaviour of pure substances.

UNIT – 3	SECOND LAW OF THERMODYNAMICS	9

Statements - Heat engines - Carnot's theorem - Ideal-gas temperature scale - Carnot's equations - Concept of entropy - Entropy changes of an ideal gas undergoing a mechanically reversible process in a closed system - Mathematical statement of the second law - Entropy balance for open systems - Residual properties – Maxwell's relations and applications - Statement of the third law of thermodynamics.

UNIT – 4	PHASE EQUILIBRIA	9

Criteria for phase equilibrium - Phase rules - Vapor – Liquid equilibrium calculations for binary mixtures - Liquid – Liquid Equilibria and Solid- Liquid Equilibria.

UNIT – 5	CHEMICAL REACTION EQUILIBRIA	9

Application of equilibrium criteria to homogenous chemical reactions - Standard Gibbs energy change and the equilibrium constant - Evaluation of equilibrium constant - Effect of temperature and pressure on the equilibrium constant - Relation of equilibrium constants to composition - gas-phase reactions - liquid-phase reactions - equilibrium conversions for single reactions - single- phase reactions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will

CO1	Understand the basic laws of thermodynamics, property relations, Fundamentals of phase equilibria and chemical reaction equilibria	Understand
CO2	Derive the thermodynamics property relations in accordance with laws of thermodynamics and also derive the chemical reaction equilibria and chemical reaction equilibria.	Apply
CO3	Analyze the basic concepts of classical and statistical thermodynamics.	Analysis

CO4	To know about engineering thermodynamics and understand the practical implications of thermodynamic law in engineering design.	Evaluate
CO5	Implement second law and analyze the feasibility of systems/devices; understand the real gas behavior.	Implement

TEXT BOOKS:

1. Smith, J.M., Van Ness, H.C., and Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics",6thEdn., McGraw Hill International Edition, Singapore 2001.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.

REFERENCES:

1. Sandler S.I., "Chemical and Engineering Thermodynamics", John Wiley, 2nd Edition, 2014.
2. Bevan O.J, Juliana B.G., "Chemical Thermodynamics: Advanced Applications", Academic Press, 2000.
3. Batter J.A., "Chemical Thermodynamics", Nabu Press, 2nd Edition, 2013.

19UBT305	PRINCIPLES OF GENETICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn the fundamentals of genetics, Mendelian principle and its derivatives.
- Acquire the knowledge of chromosome structure and their functions.
- Understand the concepts of sex chromosome, links, disorders, gene mapping and regulations.

UNIT – 1	CLASSICAL GENETICS	9

Structure and Functions of DNA – Genomes - Mitosis & meiosis - Mendel's principles and experiments - Sex Determination and Linkage – Pedigrees - Linkage and Mapping - Extensions of Mendelian genetics - Gene Interaction - Relationship of genotype to phenotype-variation in dominance patterns - Altered dihybrid ratios - Examples of gene interactions to produce variation in coat colour - Complementation test.

UNIT – 2	CHROMOSOME STRUCTURE AND ORGANIZATION	9

Chromosome structure and organization in prokaryotes and eukaryotes - Giant chromosomes – Polytene and Lampbrush – Deletion – Inversion – Translocation – Duplication - Variation in chromosomal numbers – Aneuploidy – Euploidy – Polyploidy - Ames test – Karyotyping.

UNIT – 3	GENE INTERACTIONS, LINKAGE AND MAPPING	9

Linkage - Crossing over – Cytological basis of crossing over - Chromosome mapping – Two and Three factor cross – Interference - Somatic cell hybridization.

UNIT – 4	POPULATION GENETICS	9

Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium non-random mating, population analysis, Models for population genetics. Mutation and Migration size, Genetic variation and Sociobiology.

UNIT – 5	MUTATION GENETICS	9

Introduction and Types of Gene mutations - Base substitution - Frame shift mutation - Insertion, Deletion, Missense, Nonsense mutation - Mutagens - Physical and chemical - Reverse mutation in bacteria - DNA repair mechanism - Mismatch repair photo-reactivation, Excision and SOS repair - Beneficial and harmful effects of mutations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Describe the Mendelian's laws and their interactions, gene arrangement in chromosomes and their physical importance.	Understand
CO2	Illustrate Menedelian's principles, sex influence, linkage and mutations	Apply
CO3	Infer the results of genetic experiments in animal and plant model systems.	Analysis
CO4	Examine the influences on gene expression and interactions.	Evaluate
CO5	Manipulate genetic material by modern tools with the help of knowledge gained	Modern Tool Usage

TEXT BOOKS:

1. Principles of Genetics by Gardner, Simmons, Snustad, 8th edition – John Wiley and Sons, Inc., 2003
2. Brown T.A. “Introduction to Genetics: A Molecular Approach”, Garland Science, 1st Edition, 2011.

REFERENCES:

1. Klug, W.S. and Cummings, M.R., “Concepts of Genetics”, Pearson Education, New Delhi, 2003.
2. Elrod S. and Stansfield S., “Schaum's Outline of Genetics”, Schaum's Outlines, 5th Edition, 2010.
3. Gardner, E.J, Simmons, M.J, and Snustad, D.P., “Principles of Genetics”,8th Edition, John Wiley & Sons, Singapore, 2003.
4. Strickberger, M.W., “Genetics”, 3rd Edition, Prentice Hall of India, New Delhi, 2008.

19UBT306	BIOCHEMICAL METABOLISM	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student will gain knowledge about:

- The individual metabolic pathways and its reaction chemistry
- The integration and the regulation of intermediary metabolism.

UNIT – 1	INTERMEDIARY METABOLISM-INTRODUCTION	9

Introduction to Metabolism – Catabolism – Anabolism – Catabolic - Anabolic and Amphibolic pathways - Bio Energetics - Endergonic and exergonic reactions - Coupled reactions - High energy compounds – Structural features of ATP and its free energy change during hydrolysis - Other high energy compounds - Biological oxidation - Ultra structure of mitochondrion - Electron transport chain - Electron transport complexes Complex I, II, III and IV - Uncouplers and inhibitors of respiration (Rotenone, Antimycin, Cyanide and 2,4 DNP) - Oxidative phosphorylation.

UNIT – 2	CARBOHYDRATE METABOLISM	9

Introduction - Aerobic and anaerobic pathways – Glycolysis – Gluconeogenesis - Fates of pyruvate – Conversion of pyruvate to lactate, alcohol and acetyl Co-A - TCA cycle - Amphibolic & Anaplerotic reactions - Balance sheet of glucose oxidation - Pentose phosphate pathway (HMP shunt) - Photosynthesis – 'light' and 'dark' reactions - C4 – pathway - Disorders of carbohydrate metabolism.

UNIT – 3	AMINO ACID METABOLISM	9

Protein turnover - General reaction of amino acid degradation – Transamination - Deamination and decarboxylation - Urea cycle - Biosynthesis of amino acids - Inborn errors of amino acid metabolism – Phenylketonuria – Albinism – Alkaptunuria and Maple syrup syndrome.

UNIT – 4	LIPID METABOLISM AND NUCLEIC ACID METABOLISM	9

Oxidation of fatty acid – α, β and ω types – Beta oxidations of saturated & unsaturated fatty acids - Formation of ketone bodies - Biosynthesis of fatty acids – Tri glycerol – Cholesterol - Disorders of lipid metabolism - Biosynthesis of purines and pyrimidine nucleotides - denovo and salvage pathways - Disorders of nucleic acid metabolism.

UNIT – 5	INTRODUCTION TO SYSTEMS BIOLOGY	9

Introduction to Systems Biology - Systems level understanding of biological systems - Basic concepts in Systems modeling - Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state - Merits of computational modeling, Purpose and Adequateness of Models, Model Development - Typical Aspects of Biological Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will able to

CO1	Understand the concepts of metabolism and flow of energy through the pathways in biological system	Understand
CO2	Apply the gained knowledge of Energy synthesis by understanding the biochemical metabolism and its disorders	Apply

CO3	Examine the anabolic and catabolic pathways of amino acids and disorders associated with them.	Analysis
CO4	Describe the role of lipid and nucleic acid metabolism in assimilating energy and disorders associated with them	Evaluate
CO5	Implement system biology concepts in the intricate network of metabolic interactions to study the metabolic profiles and metabolic fuel regulations.	Implement

TEXT BOOKS:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman & Company, 2004.
2. Biochemistry by Jeremy M.Berg, John L.Tymozko, Lubert Stryer, Fifth edition, W.H.Freeman and Company,1514 pages.

REFERENCES:

1. Voet D., Prat W.C., Voet J., “Principles of Biochemistry”, John Wiley and Sons, 4th Edition 2012.
2. Moran L.A., Horton R.A., Scrimgeour G., Perry M., Rawn D., “Principles of Biochemistry” Pearson New international, 5th Edition, 2014.
3. Sathyanarayana. U and Chakrapani U (2013). Biochemistry, 3rd edition, Elsevier

19UBT307	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Handle sterilization techniques and microscopy.
- Gain hands on experience on staining techniques, biochemical characterization of bacteria and culturing microorganisms.
- Familiarize with activity of antibiotics and disinfectant on microbial growth.
- Monitor growth of microorganisms at different physiological conditions

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Equipment usage and Sterilization Techniques
2. Culture Media-Types and Use; Preparation of broth and agar
3. Isolation techniques – serial dilution, pour plate, spread plate, streak plate
4. Culturing and preservation techniques of microorganisms(bacteria)
5. Handling, Working and care of Microscope.
6. Smear preparation and Staining Techniques – simple, gram and acid fast staining
7. Growth Curve studies on Bacteria
8. Quantification of Microbes – TVC
9. Effect of Temperature on Growth of Bacteria
10. Effect of UV radiation on Growth of Bacteria
11. Antibiotic Sensitivity Assay
12. Effect of Disinfectants- Phenol Coefficient

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to:

- Handle sterilization techniques and follow good laboratory practices in microbiology laboratory.
- Illustrate isolation, subculture, identification and preservation of microbe using appropriate basic microbiology technique.
- Evaluate the activity of antibiotics and disinfectant on microbial growth.
- Monitor different phases of microbial growth.
- Interpret the effect of pH, temperature and irradiation on microbial growth

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Light Microscope	2
2.	Shaking incubator	2
3.	Autoclave	1
4.	Laminar Air Flow	1
5.	pH meter and Thermometer	1
6.	Micro-pipettes and tips	1
7.	Distillation Unit	1
8.	Inoculation loop and L-rod	1
9.	Gas Burner	1

10.	Magnetic stirrer with beads	2
11.	Heating mantle	2
12.	Weighing balance	1
13.	Refrigerator (4°C)	1
14.	-20°C Deep freezer	1
15.	Hot air oven	1
16.	UV-Visible Spectrophotometer	1

Glassware, Chemicals, Media as required

TEXT BOOKS:

1. Cappuccino, J.G. and N. Sherman “Microbiology: A Laboratory Manual”, 4th Edition,
   Addison-Wesley, 1999.
2. Collee, J.G. et al., “Mackie & McCartney Practical Medical Microbiology” 4th Edition, Churchill Livingstone, 1996.

19UBT308	INSTRUMENTAL METHODS OF ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Practice and visualize the theory concepts of instrumental analysis.
- Gain practical knowledge and interpretation on qualitative and quantitative analysis of different molecules.

LIST OF EXPERIMENTS:

1. Precision and validity in an experiment using absorption spectroscopy.
2. Validation of lamberts - beer law using $KMnO_4$
3. Experiment to find maximum absorbance wavelength in spectrometer
4. Separation of microbial cells by differential centrifugation.
5. Separation technique-Thin Layer Chromatography.
6. Separation technique-Column Chromatography
7. Estimation of $Al3^+$ by flourometry
8. Estimation of sulphate ions by nephelometry.
9. Chemical Actinometry using potassium ferrioxolate.
10. Separation of proteins by SDS electrophoresis.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Demonstrate various quantitative analysis of molecules in given samples.
- Analyse the biomolecules using separation technology.
- Evaluation of ions for the study of physical characteristics.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	1
2	Colorimeter	2
3	Centrifuge	1
4	Nephelometry	1
5	Thin Layer Chromatography	5
6	Column Chromatography	5
7	SDS – PAGE Unit	1

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Skoog, D.A. et al. “Principles of Instrumental Analysis”, V Edition, Thomson / Brooks – Cole, 1998.
2. Braun, R.D. “Introduction to Instrumental Analysis”, Pharma Book Syndicate, 1987.
3. Willard, H.H. et al. “Instrumental Methods of Analysis”, VI Edition, CBS, 1986.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, V Edition, McGraw-Hill

19UMA424	PROBABILITY AND INFERENTIAL STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To provide necessary basic probability concepts and standard distributions that candescribe real life phenomena.
- To make the student acquire skills in handling situations involving more than one randomvariable and functions of random variables.
- To make the student understand and characterize phenomena which evolve with respectto time in probabilistic manner.
- To familiarize the student to analyze the response of random inputs to linear time invariantsystems.

UNIT – I	PROBABILITY & STATISTICAL DISTRIBUTIONS	9 + 3

Axioms of probability – Conditional probability – Total probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions and their properties. Binomial, Poisson, Normal, Geometric, Uniform, Exponential and Gamma distributions.

UNIT – II	TWO DIMENSIONAL RANDOM VARIABLES	9 + 3

Joint probability distributions – Marginal and Conditional distributions – Covariance – Correlation
and Regression – Transformation of random variables – Central limit theorem.

UNIT – III	CORRELATION AND SPECTRAL DENSITIES	9 + 3

Random Process – Introduction – Auto Correlation Functions – Cross Correlation Functions – Properties – Power Spectral density – Cross spectral density – Applications of correlations and Spectral Densities.

UNIT – IV	LINEAR SYSTEMS WITH RANDOM INPUTS	9 + 3

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output – White noise.

UNIT – V	TESTING OF HYPOTHESIS	9 + 3

Sampling distributions – Normal, t, Chi-square and F distributions – Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

TOTAL : 45 (L) + 15 (T) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply the knowledge of probability to acquired knowledge of standard distributions.	Apply
CO2	Analyze joint probability distributions, principles of linear correlation and regression and central limit theorem to describe inferences.	Analyze
CO3	Apply the knowledge of correlations and spectral densities in random process.	Apply
CO4	Apply the acquired fundamental knowledge on random process in linear system with random inputs in the areas of communication	Apply

	and signal processing.	
CO5	Apply the concept of testing of hypothesis for small and large samples in Real life Problems.	Analyze
CO6	Understand the basic concept of probability, Random Variable and statistics.	Understand

TEXT BOOKS:

1. Veerarajan, "Probability and Random Processes", 4th edition, 2015.
2. Gupta S.C, Kapoor V.K. "Fundamental of Mathematical Statistics" 10th Edition, SultanChand and Sons, New Delhi, 2002.

REFERENCES:

1. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India,Bangalore, 2nd Edition, 2012.
2. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications toSignal Processing", Pearson Education, Asia, 3rd Edition, 2002.
3. Walpole. R.E., Myers .R.H., Myers S.L., and YE. K, "Probability and Statistics for Engineers and Scientists", Pearson Education, New Delhi, 8th edition, 2007.
4. Veerarajn.T., "Probability and Statistics", Tata McGraw Hill Publishing company Limited 2008.
5. Oliver C. IBE, "Fundamentals of Applied probability and Random processes", Elsevier,Lowell, Massachusetts, 1st Indian Reprint, 2007.
6. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, New Delhi, 4th Edition, 2002.

19UBT402	CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student gain knowledge and understand

- Structure, function of cell organelles, different receptors and model of signaling.
- Transport mechanisms across membranes.
- Signal transduction and cyclic pathway of cells.

UNIT – 1	AN OVERVIEW OF CELLS	9

Introduction to Cell Biology - Origin and evolution of cell - Evolution of metabolism - Origin of Prokaryotes - Origin of Eukaryotes - Development of multicellular organisms - Cells as experimental models - Tools of cell biology - Biosynthesis of cellular constituents.

UNIT – 2	ORGANELLAR FUNCTIONS	9

Cytoskeletal proteins - Cytoskeleton function – Myocytes, Cilia, Flagellar movement and Intermediate filaments – Nucleus – Nucleolus - Organization of genome - Golgi bodies - Endoplasmic reticulum- Overview of protein synthesis and transport - Ribosomes – Role in protein synthesis - Mitochondria – Respiration – TCA – Plastids – Types – Functions - Overview of photosynthesis.

UNIT – 3	TRANSPORT ACROSS CELL MEMBRANES	9

Passive and Active Transport; Permeases; Ion channels; ATP pumps – Sodium Potassium pumps – Calcium pumps – Uniport – Symport - Antiportersystem - Ligand gated / voltage gated channels - Agonists andAntagonists.

UNIT – 4	CELL SIGNALING AND REGULATION	9

General principles of cell signaling - Modes of cell-cell signaling - Pathways of intracellular signal transduction - Function of cell surface receptors - GPCR pathway - cAMP pathway - Receptor protein tyrosine kinase pathway - MAPK pathway - Intracellular receptor pathways - Nitric oxide pathway - Intracellular signal transduction - Second messengers.

UNIT – 5	CELL DIVISION, APOPTOSIS AND DIFFRENTIATION OF CELLS	9

Mitosis - Stages of mitosis - Meiosis - Meiosis I and Meiosis II - Cell death – Necrosis - Programmed cell death – Apoptosis- Extrinsic pathway - Intrinsic pathway - Cell differentiation - Stem cells - Embryonic stem cells - Adult stem cells – Therapeutic applications of stem cells.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles	Understand
CO2	Distinguish the structure of prokaryotic and eukaryotic cell, articulate how energy is used and generated in cells.	Apply
CO3	Analyze the organization of Genes and chromosomes, chromosome morphology and its aberrations, Infer the malfunctioning of signaling pathways	Analysis
CO4	Evaluate the complexities involved in cell signaling	Evaluate

CO5	Utilize their knowledge in changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.	Modern Tool Usage

TEXT BOOKS:

1. Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; ‘’Molecular Cell Biology’’, IX edition, 2021.
2. Channarayappa, “Cell biology,” Universities Press, 2010.

REFERENCES:

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Dennis Bray, Karen Hopkin, Keith Roberts, Peter Walter: Essential Cell Biology, Garland Science, 2009.
2. G. Karp, Cell and Molecular Biology, 6th Edition, Wiley, 2009.
3. Thomas D. Pollard, William C. Earnshaw and Jennifer Lippincott-Schwartz: Cell Biology: With Student Consult Online Access, Saunders College Publishing, 2nd Edition, 2007.
4. Dornel J. Lodish H, Baltimore D. “Molecular Cell Biology”, W.H. Freeman, 1990

19UBT403	BASIC INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Acquire basic knowledge in fermentation, product recovery, production of biological products and strategies used in the production of primary and secondary metabolites.
- Learn about the strategies used in the production of enzymes, modern recombinant products and other biological products

UNIT – 1	INTRODUCTION TO INDUSTRIAL BIOPROCESS	9

Traditional and Modern Biotechnology - A brief survey of organisms, processes and products - Stages in Bioprocess cultivation - Upstream processing: Microorganisms, Medium components, Physical parameters - Biological waste as substrate - Types of fermentation – Batch - Fed batch – Continuous – Aerobic and Anaerobic - Downstream processing - Unit operations - Principles - Process flow sheeting - Block diagrams - Pictorial representation

UNIT – 2	PRODUCTION OF PRIMARY METABOLITES	9

Primary Metabolites- Production of commercially important primary metabolites like organic acids - citric acid, lactic acid and acetic acid, Amino acids: glutamic acid, phenylalanine and aspartic acid and alcohols – ethanol and butanol – Related industries.

UNIT – 3	PRODUCTION OF SECONDARY METABOLITES	9

Processes and production of various classes of secondary metabolites – Antibiotics - beta lactams - Penicillin and Cephalosporin, Aminoglycosides – Streptomycin, Macrolides - Erythromycin, Vitamins - Cyanocobalamine and Steroids – Related industries.

UNIT – 4	PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS	9

Production of industrial enzymes – Proteases – Amylases - Lipases and Cellulases - Production of bio-pesticides, bio-fertilizers - Single cell protein – Bio-preservatives - Nisin - Biopolymers - Xanthan gum and Poly hydroxyalkoanates - Dairy product – Cheese – Related industries.

UNIT – 5	PRODUCTION OF BIOPHARMACEUTICAL PRODUCTS	9

Production of recombinant proteins having therapeutic and diagnostic applications – Streptokinase – Immunoglobulin – Insulin – Interferon - Tissue plasminogen activator – Vaccines - Monoclonal antibodies - Products of plant and animal cell culture – Related industries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe principles and strategies used industrial bioprocess and ways to improve it.	Understand
CO2	Employ the knowledge on the production of economically important bio-products.	Apply
CO3	Solve the problems in enzyme and metabolite production.	Analyze
CO4	Examine the results of the bioprocess and enhance their production.	Evaluate

CO5	Plan the strategies for efficient production and recovery of the biopharmaceutical products in industries.	Implement

TEXT BOOKS

1. Cruger,W., Crueger A., “Biotechnology: A Textbook of Industrial Microbiology”, Panima Publishing, 2nd Edition, 2000.
2. A.H.Patel., Industrial microbiology, Laxmi Publications Publishers India, 2nd edition (2016).

REFERENCES

1. Rehm, H.J., Reed, G., “Biotechnology-Volume 9”, Wiley VCH Publishers (New York), 2nd Edition,1995
2. Young M.M., “Comprehensive Biotechnology”, Pergamon, 2nd Edition, 2011.
3. Dubey, R.C. “A Textbook of Biotechnology” S.Chand& Co. Ltd., 4th revised Edition, 2008

19UBT404	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn enzyme reactions and its kinetics.
- Acquire knowledge about the enzyme production and purification process.
- Understand enzyme immobilization techniues and bio-sensors.

UNIT – 1	INTRODUCTION TO ENZYMES	9

Classification of enzymes - Mechanisms of enzyme action - Concept of active site and energetics of enzyme substrate complex formation - Specificity of enzyme action - Principles of catalysis – Collision theory - Transition state theory - Role of entropy in catalysis.

UNIT – 2	ENZYME KINETICS	9

Kinetics of single substrate reactions - Estimation of Michel's – Menten parameters - Lineweaver – Burk Plot - Eadie - Hofstee plot - Hanes-Woolf plot – Multi-substrate reactions - Introduction to ping-pong bi-bi mechanism – Random order mechanism and compulsory order mechanisms - Turnover number - Types of inhibition & models for substrate and product - Allosteric regulation of enzymes - Monod - Changeux - Wyman model - pH and temperature effect on enzymes - Deactivation kinetics.

UNIT – 3	ENZYME IMMOBILIZATION	9

Physical and chemical techniques for enzyme immobilization – Adsorption - Matrix entrapment – Encapsulation - Cross-linking - Covalent binding - Matrix used in immobilization - Advantages and disadvantages - Application of immobilized enzymes - Mass transfer effect on immobilization - Properties of immobilized enzymes.

UNIT – 4	PRODUCTION, PURIFICATION AND CHARACTERIZATION OF ENZYMES	9

Production and Extraction of crude enzymes from various sources like plant, animal and microbial sources – Purification - Criteria of purity – Precipitation - Dialysis and Chromatography techniques - Determination of molecular weight of enzymes – PAGE – X-ray spectroscopy-Enzyme assays - Case study- Pectinases and amylases.

UNIT – 5	ENZYME BIOSENSORS	9

Application of enzymes in analysis - Principles of electrochemistry - Design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe enzyme classification, enzyme reaction mechanisms and kinetics with production and purification techniques.	Understand
CO2	Apply the kinetics of enzyme reaction, the ways of its inhibition and pH and temperature effects on enzyme reactions on production and purification techniques.	Apply
CO3	Analyze fundamental concepts of enzyme immobilization	Analysis

	along with its properties and the mass transfer effects on immobilized enzymes.	
CO4	Summarize the production, purification strategies, characterize enzymes and find method to enhance it.	Evaluate
CO5	Implement the knowledge for the production enzyme biosensors	Implement

TEXT BOOKS:

1. Palmer, T., Enzymes: Biochemistry Biotechnology and Clinical Chemistry, East West Press Pvt Ltd, New Delhi, 2nd Edition, 2007
2. Chaplin, M. and Bucke, C. Enzyme Technology, 1st Edition, Cambridge University Press, London, 1st Edition, 1990

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

19UBT405	FLUID PARTICLE MECHANICS AND MECHANICAL OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand and apply fluid mechanics principles
- Learn various flow measuring devices and flow through packed bed and fluidized bed.
- Understand the importance mixing and agitation.
- Handle various mechanical-physical separation processes.

UNIT – 1	FLUID PROPERTIES AND FLUID MECHANICS	9

Fluid definition - compressible, incompressible fluids – coefficient of isothermal compressibility – Density - specific gravity - specific weight - surface tension - vapour pressure – viscosity - Newtonian and Non-newtonian fluids - Fluid statics – Barometric equation - Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers - Fluid Dynamics – equation of continuity – Bernoulli's equation and Navier - Stokes equation – press loss in straight pipes – in fittings – expansion and contraction losses - Fluid flow measurement - Orifice, venture & Rota meter.

UNIT – 2	FLOW OF FLUID THROUGH PACKINGS	9

Fluidization and its types - Fluid transport Industrial application of fluid flow through packing - characteristics of packed bed - Bed surface area-void fraction - Laminar flow through packed bed and turbulent flow pressure drop experienced by the fluid-equations and application problems. Fluidization phenomena-Industrial application - minimum fluidization velocities. Industrial pipes and fittings Fluid moving machinery-pumps centrifugal, Reciprocating - gear, Peristaltic pumps, Introduction to gas moving machinery-Fans, blowers, compressors.

UNIT – 3	PARTICLE SIZE REDUCTION	9

Factors affecting size reduction - comminution laws - Kicks law - Rittingers law, Bonds law and their limitations - Crushing efficiency - power consumption - Size reduction equipments - Grinder Construction - operation of Hammer mill - Ball mill - Ultrafine grinder - Fluid energy mill - Cutting machines - knife cutters.

UNIT – 4	AGITATION AND MIXING	9

Dimensional analysis - Principles of agitation - agitation of liquids; gas-liquid systems; gas-solid suspensions, mixing of powder, Viscous material and pastes - agitation equipment – Solid-Solid mixing equipment - Mixing effectiveness and Mixing index - Flow patterns in Agitated vessels – Impellers - Types of impellers - power consumption of Impellers - Agitator scale up, Particle Size, Stability, Visual Density, Stabilizers, Emulsifying – rpm, temperature, reduction.

UNIT – 5	MECHANICAL SEPARATION AND DRYING	9

Filtration - Types of filtration - Filter media - selection of medium - Filter aids – Filter theory - Types of filter – Constant pressure filtration - constant volume filtration - Industrial filtrations – Sedimentation - Batch sedimentation - Kynch theory - rate of sedimentation - Free settling - Hindered settling - Stokes law and Newton's law regimes of settling - Centrifugal force – centrifuge –Drying - Drying rate curves - Mechanism of drying - types

of dryers - Design of batch and continuous dryers - Solid Dryer Design.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Summarize the principles related to fluid properties and mechanics.	Understand
CO2	Apply the concepts of fluid transportation in chemical and biological processes and also can address problems in hydraulics	Apply
CO3	Distinguish between different mechanical operations and choose the operations needed for their product production.	Analysis
CO4	Evaluate the working of agitator by assessing its mixing efficiency and scale up agitation process and equipment	Evaluate
CO5	Design the mechanical separation processes for a specific product recovery.	Implement

TEXT BOOKS:

1. Geankoplis C.J., “Transport Processes and Separation process Principles”, Prentice Hall International, 4th Edition, 2015.
2. McCabe W.L., Smith J.C., “Unit Operations of Chemical Engineering”, McGraw hill, 7th Edition 2014.

REFERENCES:

1. Coulson J.M., Richardson J.F., “Chemical Engineering - Vol. I”, Asian Books Pvt. Ltd., India, 6th Edition, 2006.
2. Foust A. S., Wenzel L.A., Clump C.W., Naus L., Anderson L.B., “Principles of Unit Operations”, John Wiley & Sons, 2nd Edition, 2008.
3. Robert W.Fox, Alan T.McDonald& Philip J.Pritchard “Introduction to Fluid Mechanics” 6thedn John Wiley & Sons 2003.
4. Himmelblau D.M “Basic principles & Calculations in Chemical Engineering” 6th edn PHI 2006.

19UBT406	BIOPROCESS PRINCIPLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Develop skills of the students in design operation, medium design, optimization, fermentation process and effluent treatment.
- Understand the modern industrial biotechnological process, sterilization, metabolic stoichiometry and growth kinetics of microorganisms.

UNIT – 1	OVERVIEW OF FERMENTATION	9

Overview of fermentation industry - General requirements of fermentation processes, basic configuration of fermentor and ancillaries, Instrumentation in bioprocess: main parameters to be monitored and controlled in fermentation processes - Role of bioprocess engineer in the biotechnology industry - Unit operations involved in bioprocesses - Modern applications of biotechnological processes

UNIT – 2	RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS	9

Criteria for good medium - Medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements – Medium formulation of optimal growth and product formation, examples of simple and complex media - Design of various commercial media for industrial fermentations - Medium optimization methods, Plackett-Burman and Response Surface Methodology- Overview of animal and plant cell culture media

UNIT – 3	STERILIZATION KINETICS AND EFFLUENT TREATMENT	9

Modes of media sterilization - FSIP and ESIP, Modes of air sterilization, media sterilization by membrane filtration method - Filter sterilization of liquid media - Design of filters – Air sterilization - Types of sterilization process Batch and continuous heat sterilization of liquid media - Thermal death kinetics of microorganisms – Design of sterilization equipment and validation issues - Effluent treatment in bioprocesses, types of treatment methods, containment and effluent disposal.

UNIT – 4	METABOLIC STOICHIOMETRY AND ENERGETICS	9

Stoichiometry of cell growth and product formation - Elemental balances, degrees of reduction of substrate and biomass, available electron balances - Yield coefficients of biomass and product formation, maintenance coefficients, energetic analysis of microbial growth and product formation - Oxygen consumption and heat evolution in aerobic cultures, Thermodynamic efficiency of growth.

UNIT – 5	MICROBIAL GROWTH AND PRODUCT FORMATION KINETICS	9

Biomass estimation – Direct and Indirect methods- Modes of operation - Batch, fed batch and continuous cultivation - environmental conditions affecting the growth kinetics, heat generation by microbial growth; Industrial applications - Chemostat – Turbidostat - Introduction to unstructured models for growth and product formation - Simple unstructured kinetic models for microbial growth - Monod model - Growth of filamentous organisms - Product formation kinetics – Leudeking - Piret models, Substrate and product inhibition on cell growth and product formation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Summarize the overall bioprocess principles, Design of fermentor and fermentation media for the production of metabolites	Understand
CO2	Apply Concepts and knowledge from various biotechnological processes	Apply
CO3	Analyze the stoichiometry of cell growth and evaluate parameters in Monod kinetics	Analysis
CO4	Evaluate the microbial growth by developing microbial energetics using various methods	Evaluate
CO5	Use modern statistical tool for the optimization of enhanced production and recovery of product.	Modern Tool Usage

TEXT BOOKS:

1. Pauline, D., “Bioprocess Engineering Principles”, Elsevier, 2nd Edition, 2012.
2. Shuler, M.L., Kargi F., “Bioprocess Engineering”, Prentice Hall, 2nd Edition, 2002.

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. Stanbury, P.F., Stephen J.H., Whitaker A., “Principles of Fermentation Technology”, Elsevier, 2nd Edition, 2009.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Lydersen, B.K., “Bioprocess Engineering Systems, Equipment and Facilities” Wiley-India, 1st Edition, 2010.

19UBT407	CELL BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to

- Develop skills in the basic cell biological techniques
- Gain practice on isolation and identification of cell organelles
- Do hands-on work on basic cytogenetic techniques

LIST OF EXPERIMENTS:

1. Sterile techniques and cell propagation
2. Microscopic observation of eukaryotic cells
3. Isolation of cell organelle: chloroplast
4. Cell organelles staining techniques - nuclear staining
5. Leishman staining
6. Giemsa staining
7. Cell cycle : mitotic cell division in onion root tip
8. Osmosis and tonicity
9. Tryphan blue assay
10. Separation of Peripheral Blood Mononuclear Cells (PBMC) from blood.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Describe basic Sterile techniques and cell propagation concepts
- Apply Techniques to learn the morphology, identification and propagation of cells
- Analyze the morphology of cells organelles and effect of osmosis effect on cells
- Evaluate osmosis and tonicity effect of cells, PBMC for antibody analysis.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	2
2	Light Microscopes	4
3	Incubator Shaker and centrifuge	1
4	Incubators	2
5	Hot air oven	1
6	Laminar Flow Chamber	1

Glasswares, Chemicals, Media as required

TEXT BOOKS

1. Rickwood, D. and J.R. Harris “Cell Biology: Essential Techniques”, Johnwiley, 1996.
2. Davis, J.M. “Basic Cell Culture: A Practical Approach”, IRL, 1994.

19UBT408	FLUID PARTICLE MECHANICS & MECHANICAL OPERATIONS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Understand practically the basic chemical engineering principles and operations.
- Apply the concepts of chemical engineering for the understanding and the development of bioprocesses.

LIST OF EXPERIMENTS:

1. Laboratory regulations and safety precautions.
2. Flow measurement - Orifice meter.
3. Flow measurement – Venturimeter.
4. Flow measurement – Rotameter.
5. Pressure drop in flow through annular pipe.
6. Pressure drop in flow through packed beds.
7. Heat transfer characteristics in Shell and Tube heat exchanger.
8. Heat transfer characteristics in Parallel flow heat exchangers.
9. Heat transfer characteristics in Counter flow heat exchangers.
10. Size Reducion by Ball mill.
11. Filtration through plate and frame filter press.
12. Filtration in leaf filter.
13. Simple and steam distillation.
14. Batch Sedimentation

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Operate flow measurement devices, heat exchangers, filters and distillation unit.
- Analyzethe experimental data and interpret necessary process parameters controlling a reaction.
- Optimize the design and working principle of various Unit operations.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Orifice meter	1
2.	Venturimeter	1
3.	Rotameter	1
4.	Annular pipes	1
5.	Packed bed	1
6.	Shell and Tube heat exchanger	1
7.	Parallel and counter flow heat exchanger	1
8.	Ball mill	1
9.	Plate and frame filter press	1
10.	Filter leaf	1

11.	Distillation unit	1

Glassware, Chemicals, Media as required

TEXT BOOKS;

1. Geankoplis C.J. “Transport Processes and Unit Operations”, Prentice Hall India, 4th Edition, 2004.
2. Mccabe& Smith “Unit Operations of Chemical Engineering”, McGraw Hill, 7th Edition, 2017.
3. Brown G.G., “Unit Operations”, CBS, 1st Edition, 2005.

19UBT409	TECHNICAL SEMINAR	L	T	P	C
		0	0	0	1

OBJECTIVES:

- To encourage the students to study recent innovative advances in biotechnology engineering developments in healthcare industry.
- To prepare and present technical reports
- To encourage the students to use various teaching aids such as overhead projectors (OHP), power point presentation and demonstrative models

COURSE DESCRIPTION

- During the seminar session each student is expected to prepare and present a topic on recent innovative advances in biomedical engineering developments in healthcare industry, for 8 to 10 minutes.
- Each student is expected to present at least twice during the semester and the student is evaluated based on that presentation. At the end of the semester, the student can submit a report on the selected topic of seminar and marks are given based on the report.
- Faculty will guide and monitor the progress of the student and maintain attendance also.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Review, prepare and present technological developments in healthcare industry	Understand
CO2	Encourage the students to participate in national and international level intercollegiate competitions and make them to learn new things and develop new skills	Psychomotor domain
CO3	Solve random aptitude-based tasks constantly & consistently and face the placement interviews confidently	Affective domain

19UGM431	GENDER EQUALITY	L	T	P	C
		2	0	0	P/F

OBJECTIVES:

- To introduce basic concepts relating to gender and to provide logical understanding ofgender roles.

UNIT – I	GENDER SENSITIZATION	10

Definition of gender, Perspectives – Gender sensitive approach – Gender and sex – Social construction of gender and gender roles – Socialization – institutions of socialization – changing content and context of gender – need for re-socialization. Gender Stereotyping and Gender Discrimination.

UNIT – II	GENDER EQUALITY AND CONSTITUTION	10

Indian constitution related to equality – Fundamental rights – Directive principles of state policy – right to equality — rights against exploitation — cultural and educational rights — the right to constitutional remedy – University Declaration of Human Rights – Enforcement of Human Rights for Women and Children — Role of Cells and Counseling Centers — Internal Complaints Committee – Legal AID cells, Help line, State and National level Commission.

UNIT – III	GENDER ROLES & EQUALITY	10

Gender & Morality – Structural and functionalist views of Gender – Gender in the Classroom – Beyond access for girls and boys – Gender equality in schools – Gender equality and adult basic education – Developing capacity to achieve gender equality in education – Individuality and removal of gender stereotypes – Respect for each other's – Promote equal opportunity.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the social construction of gender and sexuality and their influence in social context.	Understand
CO2	Analyze how the concepts of gender equality are created, maintained, and/or challenged.	Analyze
CO3	Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project.	Apply

REFERENCE BOOKS:

1. Sheila Aikman and Elaine Unterhalter, "Practising Gender Equality in Education", OxfamGB, 2007.
2. Pasadena and Hackensack, "Gender roles and Equality", Salem Press, 2011.

19UBT501	MOLECULAR BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should gain knowledge and understand

- Molecular mechanism of DNA and RNA synthesis and Protein synthesis
- Mechanisms of central dogma of life
- Role of the nucleic acids in gene expression and its regulation.

UNIT – 1	INTRODUCTION TO MOLECULAR BIOLOGY	9

Scope and history - Structure of DNA - Nucleoside – Nucleotide - Base pairing - Base stacking - Double helix - Features of Watson and crick model - Major and minor groove - Supercoiling – Twist - Writhe and linking number - Conformational variants of double helical DNA - Structure and function of RNAs – mRNA- rRNA – tRNA - Secondary structures in RNA - Organization of bacterial, viral and eukaryotic chromosome.

UNIT – 2	REPLICATION AND REPAIR	9

Types and functions of DNA polymerases in prokaryotic and eukaryotic replication and proof reading activity - 5'-3' exonuclease activity - Topoisomerase activity - Telomeric DNA replication - Plasmid replication - theta model - Strand displacement model and Rolling circle model –Bidirectional – Unidirectional - DNA repair - Nucleotide excision repair - Mismatch repair - Photo-reactivation - Recombination repair - SOS repair.

UNIT – 3	TRANSCRIPTION	9

RNA polymerases in prokaryotic and eukaryotic cells - Types and their function - Promoters and transcription factors - Transcription of mRNA, rRNA, and tRNA genes in prokaryote and eukaryote - Processing – Fine structure of prokaryotic and eukaryotic genes - Post translational processing of eukaryotic mRNA.

UNIT – 4	TRANSLATION	9

Genetic code and wobble hypothesis - Process of translation in prokaryotes and eukaryotes - Post translational modifications - Protein transport and trafficking in prokaryotic and eukaryotic cells.

UNIT – 5	REGULATION OF GENE EXPRESSION	9

Regulation of Gene expression in Prokaryotes – Operan concept (Lac and Tryp) - Regulation of Gene expression in Eukaryotes – Transcriptional activation - Galactose metabolism in yeast.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Describe the composition, structures, functions and internal controls within individual cells, explain the principal molecular events of cell incorporating DNA Replication, Transcription and Translation in prokaryotic as well as eukaryotic organisms and regulation mechanisms.	Understand

CO2	Correlate DNA based technologies for innovations by clarify the nature of genes and sources of variation	Apply
CO3	Qualified analysis of DNA and proteins continues to give us a comprehensive view of patterns of variation, common ancestry, and how evolution works.	Analysis
CO4	Evaluate the complexities involved in regulatory path ways during gene expression.	Evaluate
CO5	Gain ideas to use modern tools for the study of prokaryotic and eukaryotic organisms at molecular level.	Create

TEXT BOOKS:

1. Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; ''Molecular Cell Biology'', IX edition, 2021.
2. ''Molecular Biology of the Gene VIII'' by Benjamin Lewin, James D. Watson, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick.

REFERENCES:

1. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IV Edition, John Wiley, 2005.
2. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
3. Tropp, Burton E. "Molecular Biology: Genes to Proteins". III Edition. Jones and Bartlett, 2008.
4. Glick, B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

19UBT502	BIOPROCESS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Provide the students with the basics of bioreactor engineering and acquire the concepts involved in the scale up of the reactors.
- Gain knowledge about reactor systems for immobilized enzymes and develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT – 1	CONFIGURATION OF BIOREACTORS	9

Stirred Tank Reactor - Non-ideal behaviour – RTD - Tanks-in-series and dispersion models - Application to design of continuous sterilizers - Fed batch cultivation - Cell recycle cultivation and its usage in waste water treatment - Two stage cultivation Packed bed reactor - Airlift reactor - Fluidized bed reactor - Bubble column reactors - Stability analysis of bioreactors.

UNIT – 2	SCALE – UP OF BIOREACTOR	9

Regime analysis of bioreactor processes - Oxygen mass transfer in bioreactors - Microbial oxygen – Demands - Methods for the determination of mass transfer coefficients - Mass transfer correlations - Scale up criteria for bioreactors based on oxygen transfer - Power consumption - Impeller tip speed.

UNIT – 3	MODELLING AND SIMULATION OF BIOPROCESSES	9

Study of structured models for analysis of various bioprocess - Compartmental models - Models of cellular energetics and metabolism - Single cell models - Plasmid replication - Plasmid stability models - Dynamic simulation of batch, fed batch, steady - Transient culture metabolism - Model simulation using MATLAB-SIMULINK.

UNIT – 4	BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS	9

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions – Formulation of dimensionless groups and calculation of effectiveness factors - Design of immobilized enzyme reactors - Packed bed - Fluidized bed - Membrane reactors.

UNIT – 5	RECOMBINANT CELL CULTIVATION	9

Different host vector system for recombinant cell cultivation strategies and its advantages - *E.coli* - yeast *Pichia pastoris* / *Saccharomyces cereviseae* - Animal cell cultivation - Plant cell cultivation - Insect cell cultivation - High cell density cultivation - Process strategies - Reactor considerations in the above system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Select appropriate bioreactor configurations and operation modes based upon the nature of bio-products and cell lines and other process criteria	Understand
CO2	Justify the mass transfer significance in designing of immobilized enzymes based reactors	Analyze

CO3	Design the scaled up reactors based on power, oxygen transfer and mixing time.	Evaluate
CO4	Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology	Implement
CO5	Use modelling and simulation of bioprocesses so as to reduce costs and enhance the quality of products and systems	Modern Tool Usage

TEXT BOOKS:

1. Pauline, D., “Bioprocess Engineering Principles”, Elsevier, 2nd Edition, 2012.
2. Shuler, M.L., Kargi F., “Bioprocess Engineering”, Prentice Hall, 2nd Edition, 2002.

REFERENCES:

1. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
2. Stanbury, P.F., Stephen J.H., Whitaker A., “Principles of Fermentation Technology”, Elsevier, 2nd Edition, 2009.
3. Lydersen, B.K., “Bioprocess Engineering Systems, Equipment and Facilities” Wiley- India, 1st Edition, 2010.
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

19UBT503	HEAT TRANSFER AND MASS TRANSFER OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand various modes of heat transfer operations and its mechanisms.
- Understand various types of heat exchanger and evaporators and its principles.
- Acquire knowledge on fundamentals of mass transfer operations and techniques involved in diffusion, convective mass transfer, drying, and crystallization.

UNIT – 1	PRINCIPLES OF HEAT TRANSFER	9

Introduction to various modes of heat transfer – Conduction - Steady state conduction - Combined resistances - Unsteady state conduction - Lumped heat capacity - Extended surfaces - Convection - Dimensional analysis - Forced and natural convection - Convection in flow over surfaces through pipes, boiling and condensation - Combined conduction and convection - Introduction to radiation heat transfer - Stephen Boltzmann Law - Emissivity and Kirchhoff law - Concept of grey body - Emissive power calculation.

UNIT – 2	HEAT TRANSFER OPERATIONS	9

Heat Exchangers - Flow patterns in Heat Exchangers – Types of heat exchangers - LMTD calculation - LMTD correction factors - Overall heat transfer coefficients - Design of heat exchangers - Heat exchanger effectiveness - NTU concept - Fouling factor - Evaporators – natural, forced circulation and agitated film evaporators - Methods of operation of evaporators - single-effect and multiple-effect evaporators - Evaporation of Biological materials- Fruit juices, sugar solution and paper-Pulp waste liquors- Mass and enthalpy balances.

UNIT – 3	PRINCIPLES OF MASS TRANSFER	9

Introduction to Mass transfer and diffusion - Ficks law for molecular diffusion – Molecular diffusion in gases, liquid and solids - Introduction to convective mass transfer - Convective mass transfer coefficients - Analogy between Mass, Heat and momentum transfer.

UNIT – 4	GAS LIQUID AND VAPOUR LIQUID OPERATIONS	9

Absorption - Principles of gas absorption – Single and Multi component absorption - Absorption with Chemical Reaction - Design principles of absorbers - Industrial absorbers - HTU, NTU concepts - V-L Equilibria – Distillation - Types of distillation – Simple, Steam, Vacuum, Continuous distillation - McCABE-THIELE & ONCHON-SAVARIT Principles - Industrial distillation equipments (Packed Bed)- HETP, HTU and NTU concepts.

UNIT – 5	LIQUID - LIQUID AND SOLID - LIQUID OPERATIONS	9

L-L equilibria – Batch and Continuous extractions - Solid-liquid equilibria - Leaching Principles - Adsorption equilibria – Batch and fixed bed adsorption - Drying - Batch and continuous dryers - Rate of Drying curves - Freeze drying and Sterilization of Biological materials - Crystallization theory - Equipments for crystallization, Tank, DTB Crystalliser, circulating –Magma vacuum crystallizer - Swenson walker crystalliser.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand basis of heat transfer and mass transfer operations	Understand

CO2	Apply concepts of evaporation, heat exchangers and design the respective equipment.	Apply
CO3	Analyze mass transfer coefficients for gas, liquid contacting systems.	Analysis
CO4	Evaluate the number of stages for distillation and absorption column for an industrial usage	Evaluate
CO5	Implement the learnt concepts to solve the problems related to extraction, leaching, adsorption and drying.	Implement

TEXT BOOKS:

1. Treybal, R.E.- Mass Transfer Operations- McGraw Hill, New Delhi- 3rd Edition- 1981
2. Geankoplis, C.J.- Transport Processes and Unit Operations- Prentice Hall of India, New Delhi- 3rd Edition- 2002.

REFERENCES:

1. Coulson, J.M., Richardson, J.F., Backhurst, J.R., Harker, J.M., Coulson and Richardsons Chemical Engineering - Volume II - Butter worth Heinemann, Oxford- 5th Edition- 2002.
2. McCabe and Smith, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, 2009.
3. K.V.Narayanan and Lakshmikutty, Chemical Process Calculations, Prentice Hall, 2004.

19UBT504	PROTEIN ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins

UNIT – 1	BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS	9

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, Xray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

UNIT – 2	PROTEIN ARCHITECTURE	9

Primary structure: peptide mapping, peptide sequencing - automated Edman method & massspec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turnbeta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites.

UNIT – 3	TERTIARY STRUCTURE	9

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects

UNIT – 4	STRUCTURE-FUNCTION RELATIONSHIP	9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacterio rhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects

UNIT – 5	INTRODUCTION TO PROTEOMICS	9

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the role of functional proteins in various field of study	Understand

CO2	Practice the latest application of protein science in their research	Apply
CO3	Analyze the various interactions in protein makeup	Analysis
CO4	Evaluate the protein-protein interactions.	Evaluate
CO5	Apply the gained knowledge in advanced studies of protein and their nature	Implement

TEXT BOOKS:

1. Branden C. and Tooze J., “Introduction to Protein Structured” 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. “Proteins” 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, “Proteomics: Protein Sequence to Function”. Viva Books, 2002.
4. Liebler, “Introduction to Proteomics” Humana Press, 2002.

REFERENCES:

1. Voet D. and Voet G., “Biochemistry”. 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M.“Protein Structure: Protein Science and Engineering”. Nova Science Publications, 2011.
3. Williamson, Mike “How Proteins Work”. Garland Science, 2012

19UBT508	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Acquire skills required for handling and isolation of DNA
- Understand the chemical, biochemical and biophysical characteristics of DNA.
- Understand in overall the different methodologies in molecular biology

LIST OF EXPERIMENTS:

1. Isolation of genomic DNA from bacteria
2. Plasmid DNA isolation
3. Purity analysis of isolated plasmid DNA using spectrophotometer
4. DNA characterization by Agarose gel electrophoresis (AGE)
5. Restriction digestion of Plasmid DNA
6. Ligation of digested DNA
7. Competent Cell Preparation
8. Transformation
9. Selection of recombinants – Antibiotic sensitivity assay
10. Polymerase Chain Reaction
11. Elution of DNA from agarose gels

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Gain the technical skills involved in extraction, manipulation of biomolecules and identification of gene and its expressions.
- Apply the isolation and transformation techniques for the development of new research.
- Analyze nucleic acids and its characteristics so as to study the gene variations
- Gain knowledge to undertake research projects in the area of modern biology

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1	Spectrophotometer	2
2	Light Microscopes	4
3	Incubator Shaker	1
4	Incubators	1
5	Thermo cycler	1
6	Laminar Flow Chamber	1
7	Electrophoresis setup and Gel doc	2

Glasswares, Chemicals, Media as required and DNA kits

TEXT BOOKS

1. Sambrook et al., “Molecular Cloning” A Laboratory Manual
2. Berger S.I., Kimmer A.R., “Methods in Enzymology - Volume 152”, Academic Press, 1st Edition, 1987

19UBT509	BIOPROCESS PRINCIPLES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Develop knowledge and skills in enzyme characterization, immobilization
- Develop their knowledge and skills in optimizing the medium and process parameters for the effective fermentation process.

LIST OF EXPERIMENTS

1. Enzyme kinetics – Determination of Michaelis - Menten parameters
2. Enzyme activity – Effect of Temperature and pH
3. Enzyme activity – Deactivation Kinetics
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment
6. Enzyme immobilization – Cross-linking
7. Enzymatic conversion in Packed bed Column
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, YieldCoefficient.
9. Preparation of fungal biomass by solid state fermentation.
10. Optimization by Plackett-Burman Design
11. Optimization by Response Surface Methodology.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to:

- Understand the concepts of enzyme immobilization.
- Illustrate practical skill in solid state fermentation
- Develop an optimal design of medium and process parameters for microbial growth and product production.
- Evaluate enzyme kinetic parameters and optimize the specific activity on pH and temperature.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Light Microscope	2
2.	Shaking incubator	2
3.	Autoclave	1
4.	Laminar Air Flow	1
5.	Centrifuge	1
6.	pH meter and Thermometer	1
7.	Micro-pipettes and tips	1
8.	Distillation Unit	1
9.	Inoculation loop, L-rod and Gas Burner.	1
10.	Magnetic stirrer with beads	2
11.	Heating mantle	2

12.	Weighing balance	1
13.	Refrigerator (4°C)	1
14.	-20°C Deep freezer	1
15.	Hot air oven	1
16.	UV-Visible Spectrophotometer	1
17.	Cyclomixer (Vortex)	1

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Bailey, J.E. and Ollis, D.F., “Biochemical Engineering Fundamentals", McGraw Hill, 2nd Edition, 2010.
2. Pauline, D., “Bioprocess Engineering Principles”, Elsevier, 2nd Edition, 2012.
3. Stanbury, P.F., Stephen J.H., Whitaker A., “Principles of Fermentation Technology”, Elsevier, 2nd Edition, 2009.

19UBM507	CREATIVE THINKING AND INNOVATION PROJECT	L	T	P	C
		0	0	2	1

PREAMBLE:

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

COURSE OBJECTIVES:

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

COURSE CONTENT:

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

LIST OF ACTIVITIES:

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation)	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques
Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 6	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 7	Explains about the Market Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation
Week 8	Facilitates the students work	Preparation of Innovation Development Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

		TOTAL : 30 PERIODS
ASSESSMENT PATTERN: 1. Internal Assessment: Presentation on the Innovative Idea 2. End Semester Assessment: o Submission of Business Plan o Presentation on My Startup Idea (Evaluator : From Industry)		
COURSE OUTCOMES: **At the end of the course the student will be able to:**		
CO1	Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice.	Valuing – Affective Domain
CO2	Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development.	Organization – Affective Domain
CO3	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task.	Organization – Affective Domain

19UGS533	INTERPERSONAL SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

List of Exercises

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Communicate orally with fluency and clarity in a given contextual situation	Responding - Affective Domain
CO2	Evaluate a speech and offer constructive evaluation of the speech	Evaluating - Cognitive Domain
CO3	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organization – Affective Domain
CO4	Analyze a problem and find appropriate solution	Analyze – Cognitive Domain
CO5	Take decision by organizing relevant information and defining alternatives.	Create – Cognitive Domain

19UBT601	GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the gene cloning methods and the tools and techniques involved in gene cloning and genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts to produce a recombinant protein product.
- To gain knowledge on various recombinant DNA techniques and their applications

UNIT – 1	BASICS OF RECOMBINANT DNA TECHNOLOGY	9

Introduction about milestones in Genetic Engineering - Manipulation of DNA - Restriction and Modification enzymes - RFLP and RFLP markers - Characteristics of cloning vector – Plasmid-transcription and translation vectors - Design of linkers and adaptors – Homopolymeric tailing.

UNIT – 2	DNA LIBRARIES & SEQUENCING	9

Construction of genomic and cDNA libraries - Artificial chromosomes – BACs and YACs - Chromosomal walking - Screening of DNA libraries using nucleic acid probes and antisera - Southern blotting - Western blotting - Yeast di and trihybrid system. Maxam Gilbert's, Sanger's methods of DNA sequencing and modern automated DNA sequencing principles.

UNIT – 3	AMPLIFICATION OF DNA	9

Development of mutants - Single and multiple point mutations by primer extension - PCR mediated mutations - Kunkel method of mutagenesis - Random mutagenesis - Phage display Hot start PCR - Inverse PCR - Nested PCR - FRET principle - Real-time PCR/qPCR – SYBR green assay - Taqman assay and Molecular beacons.

UNIT – 4	PROKARYOTIC AND EUKARYOTIC EXPRESSION VECTORS	9

Bacteriophage vectors – Cosmid – Phasmid - Modern prokaryotic T7 expression vectors - Heterologous expression in eukaryotes - Eukaryotic Expression vector - Insect, Yeast and Mammalian vectors - Viral vectors used for gene therapy. Case study: TOPO vector-Vector Map

UNIT – 5	APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY	9

DNA fingerprinting - Gene silencing - RNAi and gene knockout - Site directed mutagenesis - Genome editing - CRISPR-Cas9 technology - TALEN tool - Modern molecular diagnostic tools - Q –PCR - Spectral karyotype Imaging – MPLA - Application of genetically modified organisms in medicine and agriculture - Biosafety guidelines and release procedure for GMOs in India - Case study: BT cotton - Safety issues

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Enumerate the basic concepts in recombinant DNA technology	Remember
CO2	Characterize the clones using the variety of screening techniques	Understand
CO3	Perform the cloning techniques of a gene of interest and what are	Apply
CO4	Correlate the significance and power of recombinant DNA technology within the constraints of environmental and ethical consequence of practicing Genetic engineering.	Analyze
CO5	Measure the parameters to be considered while designing a cloning	Evaluate

	strategy.	
CO6	The importance of PCR in cloning, diagnosis and mutant generation including the development of high value products.	Create

TEXT BOOKS:

1. Primrose S.B., Twyman R.M., “Principles of Gene Manipulation, An Introduction To Genetic Engineering “, Blackwell Publishing Professional, 7th Edition, 2006.
2. Primrose S.B., Twyman R.M., “Principles of Genome Analysis and Genomics”, Wiley Blackwell, 3rd Edition, 2002.

REFERENCES:

1. Ansubel F.M., Brent R., Kingston R.E., Moore D.D., “Current Protocols In Molecular Biology” John Wiley & Sons, LSLF Edition, 2004.
2. Berger S.l, Kimmer A.R., “Methods in Enzymology-Vol 152”, Academic Press, 1987.
3. Krebs J.E., Goldstein E.S., Kilpatrick S.T., “Lewin’s Gene XI”, Jones & Bartlett Learning; 11th Edition, 2012.
4. Brown T.A., “Genomes 3”, CBS Publishers & Distributors-New Delhi, 3rd Edition, 2006.

19UBT602	GENOMICS AND PROTEOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student gain knowledge and understand

- Molecular markers, DNA sequencing and bioinformatic tools for genome analysis
- Techniques of protein separation, sequencing, identification and protein-protein interactions
- Gene expression using northern blotting, RT-PCR and micro array
- Various genome mapping and sequencing methods

UNIT – 1	AN OVERVIEW OF GENOME	9

Introduction to genome – Transcriptome and proteome - Genome diversity - Taxonomy and significance of genomes – Bacteria, yeast, Caenorhabditis, Homo sapiens, Arabidopsis - Gene evaluation and complexity - C-value paradox - Coding and Non-coding sequences - Cot curve.

UNIT – 2	GENOME PHYSICAL MAPPING AND SEQUENCING	9

Genetic mapping – Cross breeding and pedigree analysis - DNA markers – RFLPs – SSLPs - SNPs - Physical mapping - Restriction mapping - Fluorescent in situ hybridization - Radiation hybrid mapping and Sequence tagged site mapping.

UNIT – 3	FUNCTIONAL GENOMICS	9

Functional genomics - Introduction, importance, techniques - Genome-wide random mutagenesis – Chemical and Physical techniques - Transposon mutagenesis - Homology search - Reverse genetics - High-throughput systematic gene knockout - Gene expression analysis – Subtractive hybridization - Representational difference analysis – MPSS - Microarray analysis - The Human genome project - HapMap Project - The 1000 genome project - The ENCODE Project.

UNIT – 4	PROTEOMIC TECHNIQUES	9

In-vitro and in vivo-labelling of proteins - Edman protein micro sequencing - Protein cleavage - Detection of proteins on SDS gels - Pattern analysis - Mass spectrometry – Principles of MALDI-TOF - Tandem MS-MS - Peptide mass fingerprinting.

UNIT – 5	LARGE SCALE PROTEIN PROFILING	9

Large-scale protein profiling using proteomics - Post-translational modifications - Phosphoprotein and glycoprotein analyses - Analysis of protein-protein interactions - Protein Microarray- Analytical - Reverse-phase and functional.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Discern the crucial concepts and techniques applied in genomics, transcriptomics and proteomics.	Understand
CO2	Classify the complexity of genome/ proteome structural and functional organization.	Apply
CO3	Analyze various gene expressions and functional annotation	Analysis

CO4	Evaluate mapping and sequencing strategies applied in genome sequencing projects.	Evaluate
CO5	Integration of omics approaches for improvement of life.	Create

TEXT BOOKS:

1. Sandor S., “Genomics and Proteomics: Functional and Computational Aspects”. Springer, 1st Edition reprint, 2013.
2. Hunt S.P., Livesey, F.L., “Functional genomics”, Oxford University Press, 2000.
3. Primrose S.B., Twyman R., “Principles of Genome Analysis and Genomics”. Blackwell Publishers, 3rd Edition, 2007.

REFERENCES:

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.

19UBT603	BIOETHICS, IPR AND BIOSAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create awareness, practice of Industrial biosafety regulation and bioethics
- To provide fundamental ethical to advanced clinical trial management including drug development and trial planning

UNIT – 1:	BIOSAFETY	9

Introduction to Biological safety cabinets - Horizontal & Vertical Laminar Air Flow Cabin - Fume hood - Primary and secondary containments - Biotechnology development in India - Safety issues concerning biotechnological products - Biopharma regulations - Governing biosafety – Cartagena protocol on biosafety - Conservation of biodiversity.

UNIT – 2:	AGREEMENTS, LAW AND ENFORCEMENTS	9

Overview of national regulation and international agreement on GMO - International conventions relating to IP, WIPO – Mission and activity - WTO – GATT – TRIPS - Indian IPR legislations - Animal rights and use of animals in the advancement of medical technology.

UNIT – 3:	INTELLECTUAL PROPERT	9

Types – Patents – Copyrights – Trademarks - Industrial Design - Geographical Indications – Traditional knowledge. Application process - Patent search.

UNIT – 4:	CLINICAL TRIAL MANAGEMENT	9

Project management in clinical trials - Principles of project management - Application in clinical trial management - Risk assessment - Pharmacovigilance - Project Auditing and Inspection.

UNIT – 5:	ETHICS IN CLINICAL TRIALS	9

Historical guidelines in clinical research- Nuremberg code - Declaration of Helsinki - Belmont report - Research ethics and Bioethics – Principles of research ethics - Ethical issues in clinical trials - Use of humans in Scientific Experiments; the informed consent - Introduction to animal ethics – Animal rights and use of animals - Environmental release of GMOs - Patentability of DNA – Pre-implantation genetic diagnosis and therapy - Case study - Precaution before and after environmental release of GMO's.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe various risk assessments and associated biosafety practices at industrial level	Remember
CO2	Demonstrate and Classify Biosafety levels, guidelines, norms and regulations.	Understand
CO3	Explain the ethical principles to be followed while conducting clinical trials based on the knowledge acquired on ethical issues, guideline and regulations.	Analyze
CO4	Assess GMO's and its regulation in terms of environmental release	Evaluate
CO5	Implement project management strategies to conduct clinical trials	Apply
CO6	Design and conduct of randomized clinical trials at clinical lab	Create

TEXT BOOKS:

1. Sree Krishna V, “Bioethics and Biosafety in Biotechnology”, New Age International, 2007.
2. Fleming O D and Hunt L D (Editors), “Biological Safety: Principles and Practices”, ASM press, 2006.

REFERENCES:

1. Alikhan S and R Mashelkar , “Intellectual Property and competitive strategies in the 21st century”, Wolters Kluwer, 2009.
2. DeepaGoel and Ms.ShominiParashar, IPR, Biosafety and Bioethics, Pearson Education publisher, 2013
3. Fleming, D.A., Hunt, D.L., Biological safety Principles and practices (3rd Ed). ASMPress,
   Washington, 2000
4. McFadden Elizabeth, M McFadden. “Management of Data in Clinical Trials”, John Wiley & Sons Inc, 2nd Edition, 2008

19UBT608	GENETIC ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Understand theory behind in each techniques
- Describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1. Isolation of RNA and cDNA synthesis
2. PCR amplification of genes
3. Restriction digestion and elution of DNA
4. Ligation of DNA into expression vectors
5. Transformation & Selection of recombinants – Blue white screening assay
6. Optimisation of time of inducer for recombinant protein expression
7. Protein expression profiling by SDS – PAGE, Staining and Documentation.
8. Western blotting.
9. Restriction Fragment Length Polymorphism (RFLP).
10. Colony lysate PCR.
11. Southern blotting.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to:

- Describe the principles of methods for isolation, cloning and separation of DNA from various organisms.
- Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
- Interpret the analytical results from the conducted experiment with their gained knowledge
- Handle of the hazardous chemicals with awareness and follow safety precautions in case of emergency

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Gel - Documentation	2
2.	Electrophoresis Kit	2
3.	Blotting unit	1
4.	Shaking incubator	2
5.	Autoclave	1
6.	Laminar Air Flow	1

7.	Centrifuge	1
8.	pH meter and Thermometer	1
9.	Micro-pipettes and tips	1
10.	Distillation Unit	1
11.	Inoculation loop, L-rod and Gas Burner.	1
12.	Magnetic stirrer with beads	2
13.	Heating mantle and Cyclomixer	2
14.	Weighing balance and Gel rocker	1
15.	Refrigerator (4°C)	1
16.	-20°C Deep freezer	1
17.	Hot air oven	1
18.	UV-Visible Spectrophotometer	1
19.	Thermocycler	1

Glassware, Chemicals, Media and experimental kits as required

TEXT BOOKS

1. Sambrook J., David W.R., “The Condensed Protocols: From Molecular Cloning: A Laboratory Manual” Cold Spring Harbor, 4th Edition, 2012.
2. Frederick M.A., Roger B., Robert E. K.,, David D. M.,, Seidman J.G., John A.S., Kevin S., “Short protocols in molecular biology- Volume I &II”, Wiley & sons, 5th Edition, 2002.
3. Berger Sl, Kimmer AR, “Methods In Enzymology”, Vol 152, Academic Press, 1987

19UBT609	BIOPROCESS ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Learned about mass transfer in bio reactors and sterilization kinetics
- Acquire skills and gain knowledge in bioprocesses and handling bioreactors useful for solving problems typical for the bio-industry or for research.

LIST OF EXPERIMENTS

1. Batch Sterilization kinetics
2. Batch cultivation and Estimation of K_La – Dynamic Gassing-out method,
3. Estimation of K_La – Sulphite Oxidation Method
4. Estimation of K_La – Power Correlation Method
5. Fed batch cultivation and Total cell retention cultivation
6. Continuous cultivation – experimental set up
7. Bioreactor with immobilized biocatalyst
8. Photobioreactor
9. Residence time distribution
10. Estimation of Overall Heat Transfer Coefficient
11. Estimation of Mixing Time in reactor

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to:

- Gain ability to investigate, design and conduct experiments, analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems.
- Become creative, innovative and adaptable engineers as leaders or team members in their organizations and society.
- Perform competently in chemical and bioprocess industries and become important contributors to national development.
- Demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Reactors	2
2.	Electrophoresis Kit	2
3.	Light Microscope	2
4.	Shaking incubator	2
5.	Autoclave	1
6.	Laminar Air Flow	1
7.	Centrifuge	1
8.	pH meter and Thermometer	1
9.	Micro-pipettes and tips	1
10.	Distillation Unit	1

11.	Inoculation loop, L-rod and Gas Burner.	1
12.	Magnetic stirrer with beads	2
13.	Heating mantle	2
14.	Weighing balance	1
15.	Refrigerator (4°C)	1
16.	-20°C Deep freezer	1
17.	Hot air oven	1
18.	UV-Visible Spectrophotometer	1
19.	Cyclomixer (Vortex)	1

Glassware, Chemicals, Media as required

TEXT BOOKS

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

Stanbury P.F., Stephen J.H., Whitaker A., “Principles of Fermentation Technology”, Science & Technology Books, 2nd Edition, 2009.

19UGS631	LOGICAL REASONING AND APTITUDE (Common for CIVIL, BME & BT)	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
- To familiarize the student with various principles involved in solving mathematical problems.
- To develop an understanding of the basic concepts of reasoning skills.

UNIT – I	QUANTITATIVE APTITUDE	8

Ratio and Proportion - Averages – Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest -– Time – Speed –Distance - Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.

UNIT – II	VERBAL AND NON VERBAL REASONING	7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation –– Syllogism - Coding – Decoding.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Select an appropriate technique to solve the quantitative problems within the stipulated time.	Apply
CO2	Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning.	Apply
CO3	Analyze the direction to solve equations involving one are more unknowns.	Analyze

TEXT BOOKS:

1. Dr. R.S.Agarwal, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. Abijit Guha, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition, (2013).

REFERENCES:

1. Ashish Aggarwal, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).
2. Dr.V.A.Sathgurunath’s “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011).

WEBSITES:

www.m4maths.com, www.indiabix.com,
www.fresherworld.com, www.campusgate.co.in,
www.indianstudyhub.in, www.tcyonline.com.

19UGS532	SOFT SKILLS AND COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

UNIT – I	SPEAKING SKILLS	9

Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills

UNIT – II	WRITING SKILLS	9

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation

UNIT – III	READING AND LISTENING SKILLS	9

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking

UNIT – IV	SOFT SKILLS	9

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution

UNIT – V	INTERVIEW SKILLS	9

Types of Interviews – Body Language – Professional Grooming – Basic Etiquette.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Answer the queries precisely after carefully listening to the conversation or speech.	Affective domain - Responding
CO2	Communicate orally with fluency and clarity in each contextual situation	Affective domain - Responding
CO3	Debate with clarity of thought and expression to convey their ideas politely to others	Affective domain - Valuing
CO4	Apply correct usage of English grammar in writing, fluent speaking and comprehending.	Cognitive Domain - Apply

REFERENCES:

1. Skills for Success, Listening and Speaking – Level 4 by Brooks and Margret – Oxford University Press, Oxford 2011 Edition.
2. Professional Communication by Raman, Meenakshi and Sangeetha Sharma – Oxford University Press, 2014 Edition.
3. Developing Soft Skills by Sherfield, Robert M, R J Montgomery and Patricia G Moody – Pearson Education Publishers.

19UGM632	INDIAN CONSTITUTION AND ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE (Common to BME, CSE, ECE, IT & BT)	L	T	P	C
		1	0	0	P/F

OBJECTIVES:

- The students will be exposed to fundamental rights & duties in Indian Constitution.
- The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.
- The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB…
- The student will know about the functions of judiciary and electoral process followed in the country.

UNIT – I	INTRODUCTION ON INDIAN CONSTITUTION	4

Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.

UNIT – II	PARLIAMENTARY SYSTEM	4

Parliamentary System – parliamentary system of other countries - Indian parliamentary system-Federal System – LS and RS, Centre-State Relations-Election of member of parliaments - Union Executive - President, Prime Minister, Union Cabinet. State Legislature - State Executives – election of MLA - Governor, Chief Minister, State Cabinet.

UNIT – III	JUDICIARY AND ELECTION COMMISSION	4

Supreme Court of India: Structure, Power and Functions of Supreme Court – Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lok adhalats. Elections - Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.

UNIT – IV	LOCAL ADMINISTRATION	3

Local Administration: Powers and functions of Municipalities and Panchayats System - Panchayat Raj – Co-operative Societies and Constitutional and Non-constitutional Bodies.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.	Apply
CO2	Manage complex societal issues in society with the knowledge of judiciary and local administration.	Analyze
CO3	Interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.	Evaluate
CO4	Elaborate the ethical responsibilities of municipalities, panchayats and co-operative societies.	Understand
CO5	Describe and distinguish the functioning of the parliamentary system followed in various countries.	Understand

TEXT BOOKS:

1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.
3. Brij Kishore Sharma,“Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.
5. Durga Das Basu, “Introduction to the Constitution on India”, Prentice Hall, 2001.

19UBT701	DOWNSTREAM PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Apply the fundamental concepts of bio separation engineering
- Learn and design a downstream processing for product isolation and purification
- Recognize and troubleshoot problems associated with purification of bio products.

UNIT – 1	INTRODUCTION	9

Introduction to downstream processing – Principles and characteristics of bio-molecules - Classification of bio-products - Biological activity analysis - Process economics – Capital, operating cost analysis and cost cutting strategies.

UNIT – 2	CELL DISRUPTION AND PHYSICAL METHODS OF SEPARATION	9

Pre-treatment and stabilization of bio-products - Overview of purification of intracellular and extracellular products - Cell disruption for intracellular product release – Mechanical, enzymatic and chemical methods - Unit operations for solid-liquid separation – Filtration (depth & cross flow) - Theory of Filtration for incompressible and compressible cakes - Equipment for batch and continuous Filtration – Centrifugation - Laboratory and preparative centrifuges - Differential and density gradient centrifugation – Flocculation – Sedimentation.

UNIT – 3	PRODUCT RECOVERY	9

Adsorption - Liquid-liquid extraction - Aqueous two-phase extraction - Membrane separation – Micro, Ultra, Nano filtrations - Reverse osmosis – Dialysis - Precipitation of proteins by different methods –Selective denaturation of unwanted proteins.

UNIT – 4	PRODUCT PURIFICATION	9

Chromatography - Principles, Instrumentation – Adsorption - Reverse phase - Hydrophobic interaction - Ion exchange - Gel Filtration – Affinity - Bio-affinity - Pseudo affinity chromatographic techniques - High Performance liquid chromatography (HPLC) – Analytical and preparative.

UNIT – 5	FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS	9

Crystallization- Principle - Batch and Continuous – Drying - Principle - Spray dryer - Fluidized bed dryer – Lyophilisation - Final product formulation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe recovery and purification of biomolecules by applying downstream concepts.	Understand
CO2	Apply the knowledge of unit operations for the separation of insoluble from fermentation broth.	Apply
CO3	Point out the significance of downstream processing in a bio-product separation.	Analysis
CO4	Identify skills needed to function in modern bio separation engineering.	Evaluate

CO5	Design and illustrate chromatography processes for the purification of bio molecules.	Implement

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988.
2. Sivasankar, B. “Bioseparations: Principles and Techniques”. PHI, 2005.

REFERENCES:

1. Ghosh, Raja “Principles of Bioseparations Engineering”. World Scientific, 2006
2. “Product Recovery in Bioprocess Technology”. (BIOTOL – Biotechnology by Open Learning Series). Butterworth - Heinmann / Elsevier, 2004.
3. Mccabe W., Smith J., Harriott W., “Unit Operations in Chemical Engineering” McGraw Hill, 7th Edition, 2014.
4. Asenjo, Juan A. “Separation Processes in Biotechnology”. CRC / Taylor & Francis, 1990

19UBT702	IMMUNOLOGY – BASICS FOR IMMUNOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases

UNIT – 1	INTRODUCTION TO IMMUNE SYSTEM	9

Organisation and classification of immune system – Immune cells and organs - Innate and acquired immunity - Toll receptors and responses - Classification of antigens – Chemical and molecular nature – Haptens – Adjuvants – Cytokines - Complement pathway - Antigen presenting cells – Major histocompatibility complex

UNIT – 2	HUMORAL AND CELLULAR IMMUNITY	9

Development – Maturation – Activation – Regulation - Differentiation and classification of T-cells and B-cells - Antigen processing and presentation - Theory of clonal selection – TCR – Antibodies – structure and functions – Antibodies - Genes and Generation of diversity - Antigen-antibody reactions.

UNIT – 3	IMMUNITY AGAINST PATHOGENS AND TUMORS	9

Inflammation - Protective immune responses to virus, bacteria, fungi and parasites - Tumor antigens - Tumor immune response - Tumor diagnosis - Tumor immunotherapy.

UNIT – 4	IMMUNE TOLERANCE AND HYPERSENSITIVITY	9

Immune tolerance - Immuno deficiencies - Transplantation – Genetics of transplantation - Laws of transplantation - Allergy and hypersensitivity – Types of hypersensitivity – Autoimmunity – Auto immune disorders and diagnosis.

UNIT – 5	APPLIED IMMUNOLOGY	9

Monoclonal antibodies - Engineering of antibodies - Classification of Vaccines - Methods of vaccine development - Immunodiagnostic methods (Immuno diffusion, ELISA, FACS) – Immune modulatory drugs.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Comprehend the general concepts of immune system and elaborate the cells and organs of the immune system.	Understand
CO2	Apply the concept of cell mediated immunity and complement system	Apply
CO3	Interpret the properties of antigens and antibodies with special emphasis on haptens.	Analyze
CO4	Examine various antigen-antibody interactions and techniques.	Evaluate
CO5	Illustrate the mechanisms behind hypersensitivity and autoimmunity mechanisms.	Create

TEXT BOOKS:

1. Kuby J., “Immunology”, WH Freeman & Co., 8th Edition, 2018.
2. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essential Immunology, 13th Edition, Wiley –Blackwell, 2016.

3. Judith a Owen, Jenni Punt and Sharon A Stranford, Kuby Immunology, Macmillan
Internation, 7th Edition, 2012

REFERENCES:

1. Coico, Richard “Immunology: A Short Course” VIth Edition. John Wiley, 2008.
2. Khan, FahimHalim “Elements of Immunology” Pearson Education, 2009.
3. Christine D., “Clinical Immunology and Serology: A laboratory Perspective”; F.A. Davis Co.; Philadelphia 2nd Edition, 2003
4. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006

19UBT703	BIOINFORMATICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the basic concepts, methods and tools employed in Bioinformatics.
- Solve biological problems using bioinformatics tools and handle biological databases to solve real research problems.

UNIT – 1	INTRODUCTION TO BIOINFORMATICS	9

Introduction to Operating systems - Linux commands - File transfer protocols ftp and telnet - Introduction to Bioinformatics and Computational Biology - Biological sequences - Biological databases - Genome specific databases - Data file formats - Data life cycle - Database management system models - Basics of Structured Query Language (SQL).

UNIT – 2	SEQUENCE ALIGNMENT	9

Sequence Analysis - Pair wise alignment - Dynamic programming algorithms for computing edit distance - String similarity - Shotgun DNA sequencing - End space free alignment - Multiple sequence alignment - Algorithms for Multiple sequence alignment - Generating motifs and profiles - Local alignment - Smith Waterman algorithm - Global alignment - Needleman and Wunsch algorithm – BLAST – PSIBLAST - PHIBLAST algorithms - FASTA – Algorithms –Sensitivity – Specificity - Applications - Amino acid substitution matrices PAM and BLOSUM.

UNIT – 3	PHYLOGENETIC AND STRUCTURAL BIOINFORMATICS	9

Introduction to phylogenetics - Distance based trees UPGMA trees - Molecular clock theory – Ultrametric trees - Parsimonious trees - Neighbour joining trees - Trees based on morphological traits – Bootstrapping - Protein Secondary structure and tertiary structure prediction methods - Homology modelling – ab - initio approaches – Threading - Critical Assessment of Structure Prediction - Structural genomics.

UNIT – 4	PROTEIN STRUCTURE ANALYSIS	9

Introduction Machine learning techniques - Artificial Neural Networks in protein secondary structure prediction - Hidden Markov Models for gene finding - Decision trees - Support Vector Machines. Introduction to Systems Biology and Synthetic Biology - Microarray analysis - DNA computing - Computer Aided drug discovery - Applications of informatics techniques in genomics and proteomics - Assembling the genome - STS content mapping for clone contigs - Functional annotation - Peptide mass fingerprinting.

UNIT – 5	PERL PROGRAMMING	9

Basics of PERL programming for Bioinformatics - Data types: scalars and collections – operators - Program control flow constructs - Library Functions: String specific functions - User defined functions - File handling - A Program to Store a DNA Sequence.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the basic concepts of OS, Linux commands, databases and get familiarity with biological databases.	Understand

CO2	Compute Perl programming skills in biological studies.	Apply
CO3	Compare DNA and Protein sequences using online databases and perform similarity matching.	Analyze
CO4	Determine the evolutionary relationship between organisms by phylogenetic studies.	Evaluate
CO5	Use machine learning techniques in protein structure prediction and in other fields of biotechnology.	Modern Tool Usage

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.

REFERENCES:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and SorenBrunak.
2. JamilMomand, Concepts in Bioinformatics and Genomics, 2016, 1st Edition, Oxford University Press, UK
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media.

19UBT707	SUMMER INERNSHIP	L	T	P	C
		0	0	0	1

OBJECTIVES:

The student should be made to:

- Gain a better understanding of the hospital workplace
- Develop and demonstrate knowledge necessary for plant biotechnology, clinical engineering, genetic engineering, biosafety levels and bioinformatics.
- Solve the rising challenges and specific necessities of modern day technology.

Course Requirements

Students shall work in groups (Maximum 3) and has to identify and discuss about various activities of clinical departments like Biochemistry, pathology, hematology and histopathology and activities of blood bank and also challenges in designing the biotechnology products. There shall be three reviews for the summer internship during the semester by the internship co-ordinator. The incharge faculty will review the report submitted by the student. The students should make a presentation on the progress made by him/her before the committee. The student should submit the report at the end of the semester. At the end of the internship period, the marks shall be awarded by the same co-ordinator for the report and viva-voce.

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand professional ethics and legal issues related to Biotechnology and healthcare System	Understand
CO2	Recognize the basics of working model of biomedical equipment and discover the suitable improvements and solutions to specific biotechnology issues.	Apply
CO3	Interact and network with other healthcare technology lab managers to point out the best practices and solutions for common issues	Analysis
CO4	Compare and justify better management of information regarding identification of biomedical and hospital technology planning, procurement and operation requirements.	Evaluate

19UBT708	DOWNSTREAM PROCESSING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to:

- Gain technical knowledge to perform various techniques used in Downstream Processing to recover, isolate, purify and polish a product.
- Gain hands on experience in techniques involved in Downstream processing at the laboratory scale and their influence on yield and quality of the products
- Learn the high resolution purification strategies.

LIST OF EXPERIMENTS

1. Cell disruption techniques – Ultrasonication,
2. Cell disruption techniques using French Press
3. Cell disruption using Chemical and Enzymatic methods
4. Protein Precipitation by Ammonium sulphate precipitation (Salting out method)
5. Protein Precipitation by three-phase partitioning
6. Membrane separation - Dialysis, Ultra filtration
7. Aqueous two phase extraction of biomolecules
8. High resolution purification – Affinity chromatography
9. High resolution purification – Ion exchange chromatography
10. High resolution purification - Gel permeation chromatography
11. Product polishing by Freeze drying

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to:

- Acquire knowledge on the separation of whole cells and other insoluble ingredients from the culture broth.
- Use cell disruption techniques to release intracellular products
- Implemnet various techniques like evaporation, extraction, precipitation, membrane separation for concentrating their biological products
- Learn the basic principles and handle chromatography to purify the biological products for different end uses.

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Light Microscope	2
2.	Shaking incubator	2
3.	Autoclave	1
4.	Laminar Air Flow	1
5.	Centrifuge	1
6.	pH meter and Thermometer	1
7.	Freeze Dryer	1
8.	Sonicator	1

9.	Distillation Unit	1
10.	Cross flow filtration setup	1
11.	Magnetic stirrer with beads	2
12.	Heating mantle	2
13.	Weighing balance	1
14.	Refrigerator (4°C)	1
15.	-20°C Deep freezer	1
16.	Hot air oven	1
17.	UV-Visible Spectrophotometer	1
18.	Cyclomixer (Vortex)	1

Glassware, Chemicals, Media as required

REFERENCE BOOKS

1. P.A. Belter, E.L. Cussler and Wei-Houhu – Bio-separations – Downstream Processing For biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery in Bioprocess Technology – Biotechnology by Open learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson and L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods and applications, VCH Pub. 1989.

19UBT709	IMMUNOLOGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made to

- Gain knowledge on handling of animals and different routes of immunization
- Identify and enumerate various immune system cells.
- Perform agglutination and precipitation reactions.

LIST OF EXPERIMENTS

1. Immunology lab safety operations and animal handling (demo)
2. Leishmann Staining
3. Identification of blood group
4. Latex agglutination
5. Immuno-precipitation - VDRL
6. Single Radial Immuno Diffusion (SRID)
7. Ouchterlony diffusion on gels for antibody titration
8. Rocket/Counter Current immune-electrophoresis
9. Testing for typhoid antigens by Widal test
10. Enzyme Linked Immunosorbant Assay (ELISA)
11. Isolation of monocytes from blood.
12. Western blotting of serum proteins.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

- Design and perform diagnostics tests like identification of blood cells, ELISA and Electrophoresis
- Analyze the components of blood serum by different immuno techniques
- Evaluate the effect of drugs and other foreign bodies and interpret the results to carry out research

EQUIPMENTS REQUIREMENT:

Sl. No.	Name of the equipment	Quantity required
1.	Microwave oven	2
2.	Microscopes	6
3.	Fluorescent Microscope	1
4.	Hot plate	2
5.	Vortex mixer	2
6.	Centrifuge	2
7.	Elisa reader	1

Glasswares, Chemicals, Media as required

TEXT BOOKS

1. ArtiNigam, Archana Ayyagari, “Lab Manual in Biochemistry, Immunology and Biotechnology”, McGraw Hill Education, India, 2007
2. Harlow., Edward A. Greenfield (Editor) “Antibodies A Laboratory Manual”, Cold Spring Harbor Laboratory Press, 2nd edition, 2013

19UBT804	PROJECT WORK	L	T	P	C
		0	0	24	12

OBJECTIVES:

The student should be made to:

- To investigate the societal issues in the healthcare and develop engineering solutions to human health problems.
- To engage the student in integrated activities of researching the problems in healthcare field and identifying novel solution for the unaddressed technical issues.
- To enrich the communication skills of the student and to create awareness on recent development in the medical field through project work.

Course Requirements

In this course, Students shall work in groups (Maximum 3) and focus on research problem and discover solutions by applying the knowledge of subjects that he/she has learnt upto 7thsemester. The project work is also guided by the allocated faculty member for tuning up the report. There shall be three reviews for the project work during the semester by the project review committee. The review committee consisting of the project guide and a senior faculty member, nominated by the Head of the department, in the related field of the project. The students should make a presentation on the progress made by him/her before the committee. The student should submit the report at the end of the semester. The product should be demonstrated at the time of examination. At the end of the project period, the marks shall be awarded by the same committee for the report and viva-voce.

COURSE OUTCOMES:

At the end of the course the student will be able to:

After the successful completion of this course the student will be able to

CO1	Understand the concepts in design of medical equipment, analysis and interpretation of medical data, and synthesis of the information to provide valid conclusions.	Understand
CO2	Implement technology in education and able to identify the characteristics of different types of dynamic environments in Biomedical Engineering	Apply
CO3	Apply the research knowledge to sustain the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the healthcare field.	Apply
CO4	Use the knowledge gained in biomedical instrumentation and Analyze unaddressed technical issues and develop prototype model according to the need of the society	Analysis
CO5	Categorize the list of problems in biomedical equipment development using different strategies to state the problem precisely, and point out the possible solutions	Analysis
CO6	Communicate the technical information effectively in oral presentation and technical report writing	Evaluate
CO7	Develop the medical products based on the need for sustainable development and offering the biomedical engineering solutions in societal and environmental contexts.	Create

19UBT901	ARTIFICIAL INTELLIGENCE IN BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To equip students with a conceptual understanding of AI and its applications through case studies using machine learning models
- To discuss the modelling and analysis of the clinical decision support systems

UNIT – 1:	Foundations	9

Introduction to Human and Artificial Intelligence: terminologies, computational models of intelligence; conceptual frameworks from cognitive and educational psychology, neuroscience, information theory, and linguistics; philosophical foundations of AI, Forms of Learning: supervised, semi-supervised, unsupervised, active, and transfer learning, Emerging paradigms and concepts in artificial social and emotional intelligence

UNIT – 2:	Applications	9

Unique characteristics and challenges in medicine and healthcare; History and status quo of intelligent and expert systems in medicine. Risk stratification, patient outcome prediction, disease progression modeling,

UNIT – 3:	Decision-making and intelligent systems	9

Clinical decision-making and intelligent systems to support evidence-based medicine - Phenotype and clinical/bio-marker discovery, Relevance to personalized medicine - Analysis of tissue morphology and other medical imaging applications. Case study

UNIT – 4:	Implementation	9

Implementation – Major issues of implementation – implementation strategies – Models of integration - Intelligent decision support systems – Intelligent modelling and model management – Problems and issues in integration - impact of management support systems - Ethics of AI: bias, fairness, accountability, and transparency in machine learning - Ethical, Legal, and Social Issues of AI in medicine and healthcare

UNIT – 5:	Evaluation	9

Tools and Technologies for implementing AI method, Model evaluation and performance metrics, cross-validation, model interpretability, Case study

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand models of human and artificial intelligence, specifically computational models of intelligence.	Understand
CO2	Comprehend a collection of machine learning models (identified and covered in the course), and their applications in medicine and healthcare.	Analyze
CO3	Identify and apply appropriate intelligent system models and computational tools to specific problems in biomedicine and healthcare	Apply
CO4	Analyze the performance of specific models as applied to biomedical problems, and justify their use and limitations	Analyze

CO5	Identify, understand, and interpret methods and evidence from artificial intelligence and other relevant literature	Analyze
CO6	Effectively communicate and disseminate knowledge in any science or engineering domain in the context of computing, systems, and/or biomedical applications.	Psychomotor Domain

19UBT902	BIOREMEDIATION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the basic concepts related to bioremediation
- To acquire knowledge on different strategies to improve bioremediation

UNIT – 1:	INTRODUCTION TO BIOREMEDIATION	9

Need for bioremediation, an overview of the bioremediation process- in situ and ex situ bioremediation. Microbial Communities and Bioremediation, Contaminant Bioavailability, Microbial Catabolism of Organic Pollutants, Chemical transformations and role of enzymes, Measuring Biodegradation Potential.

UNIT – 2:	BIODEGRADATION AND BIOCATALYSIS	9

General microbial strategies for initiating attack on xenobiotics - Biodegradation strategies for key classes of compounds - Factors affecting biodegradation, Biodegradation kinetics ; Biodegradation Engineering & Modelling; Biocatalysis Enzymes and major reactions and its kinetics

UNIT – 3:	MICROBIAL DEGRADATION	9

Metal Toxicity to Microorganisms, Metal Speciation and Bioavailability, Metal Inhibition of Biodegradation, Microbial Reduction of Metals by Fe(III)-reducing Bacteria, Bioremediation of Soils Polluted with Hexavalent Chromium using Bacteria, Bioremediation of nitroaromatic compounds, PCB's degradation, Soil Bioremediation Strategies.

UNIT – 4:	PHYTOREMEDIATION	9

Plant Species Involved in Phytoremediation, The Biophysical and Biochemical Mechanisms, Role of VGT in Environmental Management, Role of Phytochelatins in Phytoremediation of Heavy Metals, Nitrate Assimilation by Plants, Phytoremediation of Air Pollutants, Phytoremediation of Metals and Radionuclides.

UNIT – 5	ENGINEERING OF IMPROVED BIOCATALYSTS IN BIOREMEDIATION	9

Engineering Microbes for Improved Bioremediation, Protein Engineering for Improved Bioremediation, Heavy Metal Bioremediation using "Symbiotic Engineering", Genetic Engineering for Enhancing Phytoremediation Potential, Case studies: Aluminum Tolerant Crop Plants, superbug, Obstacles associated with the use of GEM in bioremediation applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand how different mechanisms are used by living systems for bioremediation	Understand
CO2	Demonstrate the basic concepts of bioremediation technology	Apply
CO3	Prioritize the significance of genetic engineering towards enhanced bioremediation	Analyze
CO4	Justify the selection of microbes for improved bioremediation using various strategies for the use of living organisms	Evaluate

CO5	Design the selective bioremediation strategies based on the use of different microorganisms to clean up the environment	Create

TEXT BOOKS:

1. Singh S. N, Tripathi R D, “Environmental Bioremediation Technologies”, Springer, 1 st Edition, 2007.
2. Wainright M., “An Introduction to Environmental Biotechnology”, Springer, 1 st Edition reprint, 2012.
3. Valdes .J D., “Bioremediation”, Springer, 1 st Edition, 2000.

REFERENCES:

1. Crawford R.L. and Crawford D.L “Bioremediation: Principles and Applications”, Cambridge Univ. Press, 1 st Edition, 1996.
2. Singh A.,Kuhad R C and Ward O P, “Advances in Applied Bioremediation”, Springer, 1 st Edition, 2009.
3. Wang L K, Ivanov V, Tay J and Hung Y., “Environmental Biotechnology”, Humana Press, 1 st Edition, 2010.

19UBT903	BIOPHARMACEUTICAL TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn about drug development, pharmacokinetics and pharmacodynamics of drug.
- Study about principles and process in manufacturing of Biopharmaceuticals.
- Learn about advanced drug delivery systems.
- Gain knowledgeon various biopharmaceuticals and their therapeutic action.

UNIT – 1	INTRODUCTION	9

History of pharmaceutical industry - types of therapeutic agents and their uses - Drug discovery and development stages– CADD –Pharmacoeconomics - regulatory aspects - Routes of drug administration.

UNIT – 2	DRUG ACTION, METABOLISM AND PHARMACOKINETICS	9

Pharmacodynamics - Mechanism of drug action –physic-chemical principles of drug metabolism – radioactivity – pharmacokinetics - Factors affecting ADME process.

UNIT – 3	PRINCIPLE AND PROCESS OF DRUG MANUFACTURING	9

Types of reaction process and special requirements for bulk drug manufacture - Oral dosage forms - Compressed tablets - dry and wet granulation - tablet presses - tablet coating - capsule preparation - Liquid dosage forms – Oral liquids - suspension and emulsion - Topical applications - ointment, cream and gel – Bioassay-sterility testing – test for pyrogens& endotoxins - Preservation of drugs - Packing techniques - GMP.

UNIT – 4	DRUG DELIVERY	9

Controlled drug delivery system - barriers in drug delivery - drug delivery mechanisms – oral, parenteral, transdermal - Target directed drug delivery - controlling factors (dissolution, diffusion, osmotic, chemical and environment) - barriers in drug delivery– MAbs, liposomes and nanoparticles.

UNIT – 5	BIOPHARMACEUTICALS	9

Chemistry and Mechanism of action of therapeutics like antibiotics: Penicillin, Cephalosporin, Tetracyclin, Chloramphenical, Streptomycin, Griseofulvin, Nystatin, Amphotericin – analgesics – laxatives - hormonal contraceptives – cardiovascular – antiulcer - anti diabetic drugs – tPA – EPO - Thyroid Hormones and corticosteroids - monoclonal antibodies for cancer therapy.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the mechanism of action of various biopharmaceuticals	Understand
CO2	Employ the knowledge of manufacturing of various dosage forms in pharmaceutical industries along with their practices.	Apply

CO3	Compare different dosage forms and drug delivery systems and identify the suitable for their drug.	Analysis
CO4	Interpret thekinetics of ADME process and can help to increase the drug efficacy.	Evaluate
CO5	Use of modern computational tools in various stages of drug discovery and development.	Modern Tool Usage

TEXT BOOKS:

1. Laurence Brunton (Author), Bruce Chabner (Author), Bjorn Knollman (Author). 2014.Goodman and Gilman's The Pharmacological Basis of Therapeutics, Twelfth Edition,McGraw-Hill Education.
2. Finkel, Richard, etal., “Lippincott’s Illustrated Reviews Pharmacology” IVth Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.

REFERENCES:

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3. F. Brown, Anthony Mire-Sluis, The Design and Analysis of Potency Assays for Biotechnology Products: (Developments in Biologicals) London, 2000.
4. Pharmaceutical Dosage Forms and Drug Delivery Systems, H.C. Ansel, L.V. allen and N.G. Popovich, Lippincott Williams and Wilkins Publisher

19UBT904	PRINCIPLES OF FOOD PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

UNIT – 1:	FOOD AND ENERGY	9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics

UNIT – 2:	FOOD ADDITIVES	9

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT – 3:	MICROORGANISMS ASSOCIATED WITH FOOD	9

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT – 4:	FOOD BORNE DISEASES	9

Classification – food infections – bacterial and other types; food intoxications and poisonings – bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.

UNIT – 5:	FOOD PRESERVATION	9

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	State the different constituents present in food and microorganism involved in processing of food	Understand
CO2	Correlate the principles and different preservations techniques of food for improving shelf life of food	Apply
CO3	Point out the concepts of unit operations in modern food processing and analyze the impact of process on food quality	Analyze
CO4	Evaluate food quality based on measure of perception by human senses	Evaluate
CO5	Develop evaluation technologies to comprehensively evaluate the quality of food	Create

19UBT905	PROCESS ECONOMICS AND PLANT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student gain knowledge and understand

- To prepare balance sheet and profit-loss statements to prepare balance sheet and profit-loss statements
- The concepts of the economic balance and economic analysis of process plant concepts of the economic balance and economic analysis of process plant
- To select appropriate process for a project.

UNIT – 1	INTRODUCTION	9

Time value of money; Equivalence; Cash flow and cumulative cash position for industrial operations; breakeven point and its significance; type of estimates; cost indices, capital recovery and its real time problem; Amortization; Depreciation; Depletion.

UNIT – 2	BALANCE SHEET AND COST ACCOUNTING	9

Capital requirements for process plants; Balance sheet; Earnings, process and returns (Income statement); Economic production - break-even analysis charts; Cost accounting - pre construction cost estimation; Allocation of cost; case studies and current problems.

UNIT – 3	ECONOMIC BALANCE AND ECONOMIC ANALYSIS	9

Economic balance - batch operations-cyclic and multiple equipment units; Economic analysis of an operating plant- Appraisal value, Earning value, Stock and Bond Value; Economic analysis of a proposed plant – Capital requirements, Estimated annual return.

UNIT – 4	PLANT DESIGN ASPECTS	9

optimization and feasibility of plant design,Optimization Solution Methodologies –case study;Selection of process-factors affecting process selection; Types of project design; Importance of Laboratory development pilot plant; safety factors; types of flow diagrams; Process auxiliaries and Process utilities-piping design and layout, selection of valves, process control and instrumentation control system design, waste treatment and disposal

UNIT – 5	PLANT LOCATION AND LAYOUT	9

Factors affecting plant location, factors in planning layouts, principles of plant layout, use of cale models based on oxygen transfer and power consumption; case studies and current roblems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Practice various depreciation methods and its uses in industries for the recovery of plant costs	Understand
CO2	apply the concepts in the project works undertaken and to handle situation by solving problem	Apply
CO3	Analyse and solve the problems on profitability and replacement analysis	Analysis

CO4	Evaluate the basic economic analysis for the given project.	Evaluate
CO5	Assess the various real time data's of the industries using modern optimization tools and comment the stability of the financial statements	Modern Tool Usage

TEXT BOOKS:

1. Peters M.S., Timmerhaus K.D., “Plant Design and Economics for Chemical Engineers”, 5th Edn., McGraw Hill International Editions, New York, 2004
2. Richard L., Alee C., Economics, 11th Edition, Oxford University Press, New Delhi, 2008.

REFERENCES:

1. Robin Smith, Chemical Process Design and Integration, Second edition, John Wiley & Sons, United States, 2016.
2. Rehm H.J., Reed G., “Biotechnology: A Multi Volume Comprehensive Treatise - Special Processes”, Volume-10 Wiley VCH, 2nd edition, 2010.
3. Couper J.R., “Process Engineering Economics”, CRC press, 1st Edition, 2003
4. F.C. Jelen and J.H. Black, “Cost and Optimization Engineering”, McGraw Hill, 3rd Edn., 1992.

19UBT906	MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course will provide a basic understanding of the microbial toxins and modern molecular pathogenesis.
- This course will enhance students to practice Infectious Disease Surveillance and Detection.
- This course will engage the students to work as a team to design Emerging Tools for Microbial Diagnosis.
- This course will help students to investigate host pathogen interaction and identifying virulence factors.
- This course will expose students to control pathogens by modern approaches.

Module – 1:	**OVERVIEW**	**9**

Historical perspective – discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry.

Module – 2:	**STRATEGIES**	**9**

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses.

Module – 3:	**BACTERIAL PATHOGENESIS**	**9**

Virulence, virulence-associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens: Enterotoxigenic E.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; Enterohaemerrohogic E.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, Enteroaggregative E.coli (EAEC).

Module – 4:	**VIRAL PATHOGENESIS**	**9**

Essentials of Viral Pathogenesis: History, Virus–Cell Interactions, Virus–Host Interactions, Viral virulence, - Viral Persistence, Viral Oncogenesis, Host Susceptibility to Viral Diseases. Emerging Viral Diseases - Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

Module – 5:	**INFECTIOUS DISEASE SURVEILLANCE AND DETECTION**	**9**

Surveillance Strategies, Surveillance Networks: Infectious Disease Surveillance and Early Warning Systems - Internet-Based Emerging Infectious Disease - Cell Phone Technology for Infectious Disease Surveillance. Detection and Diagnostics: Microbial Diagnostics - Rapid Infectious Disease Diagnostic Assays - Emerging Tools for Microbial Diagnosis, Surveillance, and Discovery - Biodefense and Standard Health Care - Improving Infectious Disease Surveillance and Detection.

TOTAL : 45 PERIODS

COURSE OUTCOMES: **At the end of the course the student will be able to:**		
CO1	Describe the concepts of molecular pathogenesis and State the impact of microbial toxins.	Understand
CO2	Given the microbial toxins to recognize the issues on human health and solve by using Internet-Based Emerging Infectious Disease.	Apply
CO3	Given the virulence-associated problem, define the issue precisely and examine the possible approaches related with microbial toxins.	Analyze
CO4	State the issues of microbial virulence and design novel approach with Cell Phone Technology for monitor infectious pathogens in environment.	Design
CO5	Given the problem description, examine its complexity and develop a solution and justify their correctness of Surveillance Networks.	Investigations
CO6	Demonstrate Infectious Disease Surveillance and Detection in the presence of available technology.	Apply

19UBT907	STEM CELL TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student gain knowledge and understand

- Basic underlying biology required for a clear understanding of stem cell types and their function.
- How stem cells can be used in drug development and understanding genetic disease, through to how stem cells are prepared for clinical use.

UNIT – 1	INTRODUCTION TO STEM CELLS	9

Definition; culturing and differentiation-embryonic stem cells, adult stem cells; origin and characterization of human stem cells and potential applications for stem cell research; plasticity of human stem cell research; cord blood stem cells; stem cell marker.

UNIT – 2	STEM CELL TRANSPLANTATION	9

Types of stem cell transplantation; Neural stem cells for Brain / Spinal cord repair, Miracle stem cell heart repair; Stem cell and future of regenerative medicine; Hematopoietic stem cell therapy for autoimmune disease;Prenatal diagnosis of genetic abnormalities using foetal CD 34+ stem cells; Embryonic stem cell – Germ-line therapy, Human stem cell research in India-CASE STUDIES

UNIT – 3	THERAPEUTIC APPLICATIONS OF STEM CELLS	9

Gene Therapy ; Introduction, History and evolution of Gene therapy; optimal disease targets ; Failures and successes with gene therapy and future prospect; Genetic Perspectives for Gene Therapy ; Gene Delivery methods ;: Viral vectors and Non-viral Vectors

UNIT – 4	REGENERATION AND EXPERIMENTAL METHODS	9

Germ cells; hematopoietic organs; and kidney, cord blood transplantation, donor selection, HLA matching, patient selection, peripheral blood and bone marrow transplantation, - Stem cell Techniques: fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging ,magnetic activated cell sorting (MACS).

UNIT – 5	ETHICAL ISSUES IN REGENERATIVE MEDICINE FIELD	9

Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1	Demonstrate an understanding for the concept of stem cells, and how they relate to tissue development, tissue homeostasis and repair/regeneration	Understand
CO2	Apply the principles of stem cell usage in drug development, organ transplantation and development	Apply
CO3	Analyse the challenges of delivering stem cells for clinical transplantation and ethical issues	Analysis
CO4	Estimate the complexities involved in targeting the disease site and justify the problems in medical reasearch	Evaluate

CO5	Use Techniques like FACS AND MACS help in synthesise, assessment and transfection of these cells	Modern Tool Usage

TEXT BOOKS:

1. Stem cells by C.S Potten., Elsevier, 2006.
2. Essentials of Stem Cell Biology by Robert Lanza., fourth edition. Elsevier 2014.

REFERENCES:

1. Stem cell biology and Gene Therapy by Peter Quesenberry., First Edition, Wiley-Liss, 1998.
2. Embryonic Stem cells – Protocols by KursadTurksen., Second Edition Humana Press, 2002.
3. Stem Cells: From Bench to Bedside by AriffBongso, EngHinLee., World Scientific PublishingCompany, 2005.
4. Stem cells in clinic and Research by Ali Gholamrezanezhad., Intech, 2013

19UBT908	METABOLIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the overview of metabolic pathways, methods and analysis in metabolic engineering
- Acquire knowledge on quantitative basis of enzyme kinetics and metabolic networks in single cells and at the organ level.
- Engineer organisms to produce valuable substances on an industrial scale in cost effective manner.

Module – 1	INTRODUCTION	9

Induction - Jacob Monod Model - catabolic regulation - glucose effect - camp deficiency - feedback regulation - regulation in branched pathways - differential regulation by isoenzymes - concerted feed-back regulation - cumulative feedback regulation - amino acid regulation of RNA synthesis - energy charge - permeability control passive diffusion - facilitated diffusion – active transport group transportation.

Module – 2	BIOSYNTHESIS OF PRIMARY & SECONDARY METABOLITES	9

Biosynthesis of Primary Metabolites - alteration of feedback regulation - limiting accumulation of end products – feedback - resistant mutants - alteration of permeability - Biosynthesis of Secondary Metabolites - precursor effects – prophophase - idiophase relationships – enzyme induction - feedback regulation - catabolic regulation by passing control of secondary metabolism - producers of secondary metabolites.

Module – 3	METABOLIC FLUX ANALYSIS	9

Metabolic flux analysis – Overdetermined systems - Underdetermined systems - Linear Programming - Sensitivity analysis - methods for the experimental determination of metabolic fluxes by isotope labelling - applications of metabolic flux analysis – amino acid production - Glutamic acid production.

Module – 4	METABOLIC CONTROL ANALYSIS	9

Fundamentals of Metabolic Control Analysis - control coefficients and the summation theorems - Determination of flux control coefficients - extension of control analysis to inter metabolite - optimization of flux amplifications - MFA of linear pathways - branched pathways - theory of large deviations - Case studies - Lysine biosynthesis.

Module – 5	METABOLIC ENGINEERING IN PRACTICE	9

Examples of pathway manipulation - Enhancement of product yield and productivity – Extension of substrate range - Extension product spectrum and novel products - Improvement of cellular properties - Xenobiotic degradation - Synthesis of alanine and serine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	State the role of transport processes and regulation of enzymes in metabolic pathways.	Understand

CO2	Increase the production by improving the strains and engineering their metabolic pathways.	Apply
CO3	Examine metabolic control coefficients and its role in manipulation of metabolite production.	Analysis
CO4	Determine metabolic flux using different experimental methods	Evaluate
CO5	Employ various strategies to manipulate the production of industrially important metabolites	Implement

TEXT BOOKS:

1. Eggeling L., De Graff A.A., Kramer R., Weuster D., Wiechaert W., Sonnlietner R., Sahm H., " Metabolic Engineering" Springer, 1st Edition reprint, 2004.
2. Stephanopoulas G., "Introduction to Metabolic engineering – Principles and Methodologies". Elsevier Science, 1st Edition, 2006.

REFERENCE:

1. Qiong C., "Microbial Metabolic Engineering: Methods and Protocols", Humana Press, 2nd Edition, 2012.
2. Robert V., Alfermann A.W., Johnson T.S., "Applications of Plant Metabolic Engineering" Springer, 1st Edition, 2007.
3. Alper H.S., "Systems Metabolic Engineering: Methods and Protocols", Humana Press, 1st Edition, 2013.
4. Peter, F. Stanbury., Stephen, J. Hall and Whitaker, A., Principles of Fermentation Technology, Elsevier, Science and Technology Books, New Delhi, 2nd Edition, 2005.

19UBT909	MARINE BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Know the marine organisms, their basic functions and role in the marine ecosystems.
- Understand the essential elements related to aquaculture and fish genetics.
- Acquire knowledge on production of natural marine and fishery by-products.
- Apply biotechnological methods for the conservation and protection of marine environment.

UNIT – 1	INTRODUCTION TO MARINE ENVIRONMENT	9

World oceans and seas – ocean currents - Physical and chemical properties of sea water - Zonation of sea: Euphotic zone, Bathyal zone, Abyssal zone, Benthic zone, Deep sea - Marine ecosystems and biodiversity: Phytoplanktons, zooplanktons, nektons, benthos, marine mammals, marine algae, Mangroves and Coral reef - Marine microbial diversity: Marine microbial habitats, Microbial distribution in the ocean, Factors that impact marine microbial diversity - Interactions between marine microbes and other living organisms– history of marine biology - Bio-eco-chemical cycles – food chain and food web.

UNIT – 2	FISH GENETICS AND AQUACULTURE	9

Fish genetics - Gynogenesis, Androgenesis, Polyploidy - Artificial insemination - Eye stalk ablation - Cryopreservation of fish gametes - Aquaculture - Definition - Important of coastal aquaculture - marine fishery resources – common fishing crafts and gears –aquafarm design and construction - Criteria of selection of aquaculture species - Culture practices of marine Fish, Shrimp, Crab, Lobster, Oyster, and Seaweed.

UNIT – 3	PHARMACEUTICAL IMPORTANCE OF MARINE ORGANISMS	9

Marine enzymes - Production of omega-3 fatty acids from marine organisms - Marine pharmacology: New and novel antibiotics from marine organisms – Secondary metabolites from marine bacteria - actinomycetes and marine endophytic fungi - Prebiotics and Probiotics for aquaculture.

UNIT – 4	MARINE AND FISHERY BY-PRODUCTS	9

Production of live-feeds in marine aquaculture: Rotifers, Artemia, Copepods and Microalgae - Marine algal by-products: Chitin, Chitosan, Agar, Alginates, Carrageenan and Heparin - Fishery by-products: Fish oil, Isinglass, Fish glue, Fish silage, Fin rays – Related Industries and regulations – Biofuel production.

UNIT – 5	MARINE ENVIRONMENTAL BIOTECHNOLOGY	9

Marine Pollution - Human impacts on marine microbial diversity - biology indicators (marine micro, algae) - Usage of marine microbes to ameliorate environmental deterioration - Control of oil spills and bioremediation - Effects of bio-fouling and bio-deterioration on marine structures - Protection methods against corrosion and fouling - Red tides: Causative factors and effects on the organisms of marine environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the importance of marine ecosystems, microbial biodiversity and various fish genetic techniques.	Understand
CO2	Solve problems in the production methodologies of economically and pharmaceutically important products from marine organisms.	Apply
CO3	Plan the production strategy for economically useful seaweed and fishery by-products.	Analysis
CO4	Explain the human impact on marine pollution and the usage of marine microbes for marine deterioration.	Evaluate
CO5	Employ the aquaculture practices of marine organisms and seaweeds.	Implement

TEXT BOOKS:

1. Marine Biotechnology,. Guest Editors: Song Qin, W.E.G. Muller and Edwin L. Cooper. Hindawi Publishing Corporation,2011.
2. Grand Challenges in Marine Biotechnology, P. H. Rampelotto, A. Trincone (eds.). Springer International Publishing AG,part of Springer Nature, 2018

REFERENCES:

1. Recent advances in marine biotechnology volume 3 – M.Fingerman, R. Nagabhushanam Mary – Frances Thomson.
2. Marine Biotechnology, Advances in Biochemical Engineering/Biotechnology, Le Gal Y., Ulber R. (Series editor: T. Scheper), Springer-Verlag Berlin Heidelberg, 2005.
3. Marine microbial diversity: The key to earth's habitability: A Report from the American academy of microbiology 2005.
4. Jennie Hunter-Cevera, David Karl and Merry Buckley, Published by American Academy of Microbiology, SanFrancisco, California, 2005.

19UBT910	CANCER BIOLOGY	L	T	P	C
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OBJECTIVES:

- To import knowledge on Cancer Biology fundamentals and principles of carcinogenesis.
- To discuss about molecular cancer cell biology and metastasis
- To introduce various therapeutic procedures for treating carcinoma
- To emphasize knowledge of the historical background for the development of the tumor microenvironment

UNIT – 1:	FUNDAMENTALS OF CANCER BIOLOGY	9

Regulation of cell cycle, Mutations that cause changes in signal molecules, Cancer genes - Tumor suppressor genes, oncogenes and their mutations, Modulation of cell cycle in cancer, Different forms of cancers, Clinical examination, Radiological examination, Biopsy and its type, Prediction of aggressiveness of cancer , tumor markers, Molecular tools for early diagnosis

UNIT – 2:	PRINCIPLES OF CARCINOGENESIS	9

Theory of carcinogenesis – Chemical carcinogenesis – Metabolism of carcinogenesis, principles of physical carcinogenesis – x-ray radiation – mechanisms of radiation carcinogenesis – Diet and cancer

UNIT – 3:	PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER	9

Signal targets and cancer – Activation of kinases – Oncogenes – identification of oncogenes,
retroviruses and oncogenes, detection of oncogenes, Oncogenes/proto oncogene activity, Growth factors related to transformation, Telomerases.

UNIT – 4:	PRINCIPLES OF CANCER METASTASIS	9

Clinical significances of invasion – Heterogeneity of metastatic phenotype – metastatic cascade, basement membrane disruption – Proteinases and tumour cell invasion.

UNIT – 5:	NEW MOLECULES FOR CANCER THERAPY	9

Different forms of therapy – Chemotherapy – Radiation therapy – Detection of cancers — Use of signal targets towards therapy of cancer – Gene therapy – Cancer resistance to chemotherapy - Advancement in cancer therapy, Nano systems for drug delivery. Enzyme inhibitors in relation to cancer therapy

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the basic concepts of cell cycle and mutations in pathway that causes cancer	Understand
CO2	Analyze the molecular mechanisms behind carcinogenesis	Analyze
CO3	Apply the processes of Mutation of cancer cell genomes of living cells	Apply
CO4	Investigate the various treatment procedure currently available for cancer.	Evaluate
CO5	Distinguish scientific explanations that show how the Multi-step tumorigenesis takes place and develop solution for the problem	Create