RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABUS REGULATIONS – 2017

B.Tech. BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION OF THE INSTITUTION

To be an institution of excellence in Engineering, Technology and Management Education & Research.

To provide competent and ethical professionals with a concern for society.

MISSION OF THE INSTITUTION

To impart quality technical education imbibed with proficiency and humane values

To provide right ambience and opportunities for the students to develop into creative, talented and globally competent professionals

To promote research and development in technology and management for the benefit of the society

VISION OF THE DEPARTMENT

To be a department of academic excellence focused on education, research and development and to conquer the frontiers of biotechnology, benefitting the society.

MISSION OF THE DEPARTMENT

- To impart quality technical education
- To continuously enhance and enrich the teaching / learning process
- To provide an ambience for overall development of the students to be more creative, innovative and globally competent ethical professionals
- To promote research and develop technologies and products for the sustenance and wellbeing of the society

PROGRAM EDUCATIONAL OBJECTIVES

This program enables Biotechnology graduates

I. To apply knowledge across the disciplines and in emerging areas of biotechnology for higher studies, research, employability and product development

II. To develop communication skills, sense of responsibility to protect the environment and ethical conduct towards their profession and commitment to serve the society

III. To possess academic excellence, managerial skills, leadership qualities and understand the need for lifelong learning for a successful professional career

PROGRAM OUTCOMES

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems
2. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design and Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
8. **Ethics:** Apply the ethical principles and commit to professional ethics and responsibilities and norms of engineering practices.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively in complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognise the need for, and have the preparation and abilty to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. To apply the knowledge and solve problems through clinical research and improve health related issues of the society
2. To design, develop processes and bioproducts for health care
3. Apply basic skills in Engineering to promote interdisciplinary research in Biotechnology

CURRICULUM

SEMESTER – I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS17151	Communicative English	HS	3	3	0	0	3
2	MA17151	Engineering Mathematics–I	BS	5	3	2	0	4
3	PH17151	Engineering Physics	BS	3	3	0	0	3
4	CY17151	Engineering Chemistry	BS	3	3	0	0	3
5	GE17151	Problem Solving and python Programming	ES	3	3	0	0	3
6	GE17152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7	GE17161	Problem Solving and python Programming Laboratory	ES	4	0	0	4	2
8	GE17162	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**17**	**2**	**12**	**24**

SEMESTER - II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS17251	Technical English	HS	3	3	0	0	3
	HS17252	Professional English Communication						
2	MA17251	Engineering Mathematics–II	BS	5	3	2	0	4
3	PH17253	Physics of Materials	BS	3	3	0	0	3
4	CY17202	Bioorganic Chemistry	BS	3	3	0	0	3
5	ME17251	Basic Civil and Mechanical Engineering	ES	4	2	2	0	3
6	BT17201	Biochemistry	PC	3	3	0	0	3
PRACTICALS								
7	GE17261	Engineering Practices Lab	ES	4	0	0	4	2
8	BT17211	Biochemistry Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**17**	**4**	**8**	**23**

SEMESTER – III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17351	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2	BT17301	Enzyme Technology and Bio-Transformations	PC	3	3	0	0	3
3	BT17302	Basic Industrial Biotechnology	PC	3	3	0	0	3
4	BT17303	Instrumental Methods of Analysis	PC	3	3	0	0	3
5	BT17304	Cell Biology	PC	3	3	0	0	3
6	BT17305	Stoichiometry and Fluid Mechanics	ES	5	3	2	0	4
PRACTICALS								
7	BT17311	Instrumental Methods of Analysis Laboratory	PC	4	0	0	4	2
8	BT17312	Cell Biology Laboratory	PC	4	0	0	4	2
9	HS17361	Interpersonal Skills-Listening & Speaking	EEC	2	0	0	2	1
			TOTAL	**32**	**18**	**4**	**10**	**25**

SEMESTER – IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA17353	Probability and Statistics	BS	5	3	2	0	4
2	CY17251	Environmental Science and Engineering	HS	3	3	0	0	3
3	BT17401	Chemical Thermodynamics for Biotechnologists	PC	3	3	0	0	3
4	BT17402	Unit operations	PC	3	3	0	0	3
5	BT17403	Food Biotechnology	PC	3	3	0	0	3
6	BT17404	Microbiology	PC	3	3	0	0	3
PRACTICALS								
7	BT17411	Chemical Engineering Laboratory	ES	4	0	0	4	2
8	BT17412	Microbiology Laboratory	PC	4	0	0	4	2
9	HS17461	Advanced Reading and writing	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**2**	**10**	**24**

SEMESTER - V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT17501	Bioprocess Principles	PC	3	3	0	0	3
2	BT17502	Mass Transfer Operations	PC	3	3	0	0	3
3	BT17503	Molecular Biology	PC	4	4	0	0	4
4	BT17504	Bioinformatics	PC	3	3	0	0	3
5		Professional Elective I	PE	3	3	0	0	3
6		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7	BT17511	Bioprocess Laboratory I	PC	4	0	0	4	2
8	BT17512	Molecular Biology Laboratory	PC	4	0	0	4	2
9	BT17513	Bioinformatics Laboratory	PC	2	0	0	2	1
			TOTAL	**29**	**19**	**0**	**10**	**24**

SEMESTER - VI

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT17601	Biopharmaceutical Technology	PC	3	3	0	0	3
2	BT17602	Bioprocess Technology	PC	3	3	0	0	3
3	BT17603	Genetic Engineering	PC	4	4	0	0	4
4	BT17604	Chemical Reaction Engineering	ES	3	3	0	0	3
5		Professional Elective II	PE	3	3	0	0	3
6		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7	BT17611	Bioprocess Laboratory II	PC	4	0	0	4	2
8	BT17612	Genetic Engineering Laboratory	PC	4	0	0	4	2
9	BT17613	Numerical Programming for Biotechnologists	PC	2	0	0	2	1
10	BT17614	Industry Training (2 weeks training during vacation)	EEC		0	0	0	1
			TOTAL	**29**	**19**	**0**	**10**	**25**

SEMESTER - VII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	GE17451	Total Quality Management	HS	3	3	0	0	3
2	BT17701	Downstream Processing	PC	3	3	0	0	3
3	BT17702	Immunology	PC	3	3	0	0	3
4	BT17703	Protein Engineering	PC	3	3	0	0	3
5		Professional Elective IV	PE	3	3	0	0	3
6		Professional Elective V	PE	3	3	0	0	3
7		Open Elective II *	OE	3	3	0	0	3
PRACTICALS								
8	BT17711	Downstream Processing Laboratory	PC	4	0	0	4	2
9	BT17712	Immunology Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

SEMESTER - VIII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	BT17811	Project Work	EEC	20	0	0	20	10
			TOTAL	**20**	**0**	**0**	**20**	**10**

TOTAL NO. OF CREDITS: 180

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE – I (SEMESTER-V)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT17E51	Biophysics	PE	3	3	0	0	3
2	BT17E52	Symbolic Mathematics	PE	3	3	0	0	3
3	BT17E53	Molecular Pathogenesis of Infectious Diseases	PE	3	3	0	0	3
4	BT17E54	Clinical Biochemistry	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (SEMESTER-VI)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT17E61	Animal Biotechnology	PE	3	3	0	0	3
2	BT17E62	Systems Biology	PE	3	3	0	0	3
3	BT17E63	Biological Spectroscopy	PE	3	3	0	0	3
4	BT17E64	Food Processing, Safety and Quality Control	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (SEMESTER-VI)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT17E65	Cancer Biology	PE	3	3	0	0	3
2	BT17E66	Bioconjugate Technology and Applications	PE	3	3	0	0	3
3	BT17E67	Fundamentals of Nanotechnology	PE	3	3	0	0	3
4	BT17E68	Plant Biotechnology	PE	3	3	0	0	3
5	BT17E69	Bioethics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (SEMESTER-VII)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT17E71	Genomics and Proteomics	PE	3	3	0	0	3
2	BT17E72	Bioentrepreneurship and IPR	PE	3	3	0	0	3
3	BT17E73	Basic concepts in Tissue Engineering	PE	3	3	0	0	3
4	BT17E74	Marine Biotechnology	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (SEMESTER-VII)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT17E75	Neurobiology and Cognitive Sciences	PE	3	3	0	0	3
2	BT17E76	Stem Cell Technology	PE	3	3	0	0	3
3	BT17E77	Biosafety and Hazard Management	PE	3	3	0	0	3
4	BT17E78	Advanced Immunotechnology	PE	3	3	0	0	3
5	BT17E79	Comprehensive Course for Biotechnologists	PE	3	3	0	0	3

OPEN ELECTIVE SUBJECTS FOR BIOTECHNOLOGY STUDENTS

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBM1701	Anatomy and Physiology for Engineers	OE	3	3	0	0	3
2.	OBM1702	Biomaterials and Artificial Organs	OE	3	3	0	0	3
3.	OBM1703	Fundamentals of Medical Instrumentation	OE	3	3	0	0	3
4.	OBM1704	Engineering Mechanics for Medical Applications	OE	3	3	0	0	3
5.	OCH1701	Introduction to Fertilizer Technology	OE	3	3	0	0	3
6.	OCH1706	Recent trends in water treatment	OE	3	3	0	0	3
7.	OCE1705	Basics of Architecture	OE	3	3	0	0	3
8.	OCE1706	Global Warming and Climate Change	OE	3	3	0	0	3
9.	OCS1705	IoT and its Applications	OE	3	3	0	0	3
10.	OCS1706	Programming in C	OE	4	2	0	2	3
11.	OCS1707	Programming in C++	OE	4	2	0	2	3
12.	OCS1708	Java Programming	OE	4	2	0	2	3
13.	OCS1709	Computer Programming	OE	4	2	0	2	3
14.	OEC1701	MEMS and its Applications	OE	3	3	0	0	3
15.	OIT1704	Computer Vision	OE	3	3	0	0	3
16.	OIT1706	Machine Learning and R Programming	OE	3	3	0	0	3
17.	OMT1703	Bio-mechatronics	OE	3	3	0	0	3
18.	OPH1701	Materials Synthesis and Characterization Techniques	OE	3	3	0	0	3
19.	OPH1702	Nanophysics	OE	3	3	0	0	3
20.	OCY1701	Green Chemistry in Energy and Environment	OE	3	3	0	0	3
21.	OCY1702	Interface Chemistry and Engineering	OE	3	3	0	0	3
22.	OGE1701	Human Rights	OE	3	3	0	0	3
23.	OGE1702	Foreign Language-Japanese	OE	3	3	0	0	3
24.	OGE1703	Foreign Language-German	OE	3	3	0	0	3
25.	OGE1704	Foreign Language-French	OE	3	3	0	0	3

SUMMARY

S.NO.	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3	3	-	3	-	-	3	-	**12**
2.	BS	12	10	4	4	-	-	-	-	**30**
3.	ES	9	5	4	2	-	3	-	-	**23**
4.	PC	-	5	16	14	18	15	13	-	**81**
5.	PE	-	-	-	-	3	6	6	-	**15**
6.	OE	-	-	-	-	3	-	3	-	**6**
7.	EEC	-	-	1	1	-	1	-	10	**13**
Total		**24**	**23**	**25**	**24**	**24**	**25**	**25**	**10**	**180**

SYLLABUS

HS17151 COMMUNICATIVE ENGLISH L T P C
Common to all branches of B.E. / B.Tech. Programmes 3 0 0 3

OBJECTIVES:
The student should be able to:

- Develop the basic reading and writing skills of first year engineering and technology students.
- Help the students develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- Help the students develop their speaking skills and speak fluently in real contexts.
- Help the students develop vocabulary of a general kind by developing their reading skills.

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences- developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Why Questions- asking and answering yes or no questions. Subject-Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II GENERAL READING AND FREE WRITING 9

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions.Vocabulary development-guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading- short texts and longer passages (close reading).Writing- understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one‘s friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development- synonyms-antonyms- phrasal verbs.

UNIT V EXTENDED WRITING 9

Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline-identifying main and subordinate ideas- dialogue writing. Listening – listening to talks- conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs-present/ past perfect tense.Vocabulary development-functional uses of tenses.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
- Comprehend conversations and short talks delivered in English
- Express ideas about oneself freely
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

MA17151	ENGINEERING MATHEMATICS I	LT P C
	Common to all branches of B.E. / B.Tech. Programmes	**3 2 0 4**

OBJECTIVES:

The student should be able to:

- Learn the basics and concepts of traditional calculus.
- Provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- Understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I MATRICES 15

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 15

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 15

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 15

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts – Bernoulli's formula, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS 15

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL: 75 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Apply the concept of Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems
- Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
- To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
- Solve problems involving integration using different methods such as substitution, partial fractions, by parts.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, Forty third Edition, 2014.
2. James Stewart, Calculus: Early Transcendentals, Cengage Learning, Seventh Edition, New Delhi, 2015.

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, Calculus, Wiley, Tenth Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, Third Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., Calculus Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, Engineering Mathematics Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, Thomas Calculus, Twelfth Edition, Pearson India, 2016.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, Third Edition, 2012.

PH 17151 ENGINEERING PHYSICS L T P C

Common to all branches of B.E. / B.Tech. Programmes 3 0 0 3

OBJECTIVE:

The student should be able to:

- Enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams –area moment of inertia - bending moment – cantilever - applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein‘s A and B coefficients derivation –

resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fibre optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe‘s and Lee‘s disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck‘s theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger‘s wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) – electron microscope – scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP –Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.
- Use the concepts of waves and optical devices and their applications in fiber optics.
- Use the concepts of thermal properties of materials and their applications in heat exchangers.
- Use the advanced physics concepts of quantum theory and its applications in electron microscope and material sciences.
- Apply the basic knowledge of crystallography in materials preparation and device fabrication.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. Engineering Physics, Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. Engineering Physics, Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. Engineering Physics, Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. Principles of Physics, Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. Physics for Scientists and Engineers, Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. Physics for Scientists and Engineers with Modern Physics, W.H.Freeman, 2007.
4. Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), Seventh edition, McGraw-Hill Education, 1994.
5. R. Murugeshan and Kiruthiga Sivaprasath, Modern Physics, S.Chand, 2015.

CY17151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:
The student should be able to:
- Acquire knowledge on characteristics of boiler feed water and water treatment techniques.
- Develop an understanding on surface chemistry and its applications.
- Develop an understanding of the basic concepts of phase rule and its applications towards alloying
- Acquire knowledge on different types of fuels and its characteristics.
- Obtain knowledge on batteries and fuel cell.

UNIT I WATER AND ITS TREATMENT 9
Hardness of water – types – expression of hardness – units– boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment – ion exchange process, zeolite process – potable water treatment – break point chlorination - desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9
Adsorption - types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich‘s adsorption isotherm – Langmuir‘s adsorption isotherm – contact theory – Preparation and applications of activated carbon (up flow and down flow process) -applications of adsorption on pollution abatement.Catalysis – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III PHASE RULE, ALLOYS AND COMPOSITES 9
Phase rule - introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.Alloys - definition- properties of alloys- significance of alloying- functions and effect of alloying elements- nichrome and stainless steel (18/8) – heat treatment of steel. Composites- polymer matrix composites -metal matrix composites-ceramic matrix composites.

UNIT IV FUELS AND COMBUSTION 9
Fuels - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gas (LPG) - power alcohol and biodiesel.Combustion of fuels - introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9
Batteries - components – Characteristics – voltage , current , capacity, electrical storage density, energy density, discharge rate – types of batteries – primary battery (dry cell)- secondary battery (lead acid battery, Ni- Cdbattery,lithium-ion-battery) .Fuel cells – H_2-O_2fuel cell, methanol oxygen fuel cell, Proton exchange membrane fuel cell – SOFC and Biofuel cells.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the students will be able to:
- Get familiarized on water treatment techniques.
- Apply adsorption phenomena on various fields.
- Analyse alloying composition based on phase rule concept.

- Apply the role of fuels in day today applications.
- Design batteries and fuel cells.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, Engineering Chemistry, Seventeenth edition, Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
2. S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India PVT, LTD, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, Engineering Chemistry, Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, Engineering Chemistry, Cengage Learning India PVT, LTD, Delhi, 2015.
3. ShikhaAgarwal, Engineering Chemistry-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
4. S. S. Dara and S. S. Umare, A Textbook of Engineering Chemistry, Twelfth edition, S. Chand & Company LTD, New Delhi, 2015.

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The student should be able to:

- Develop an understanding of algorithmic problem solving
- Develop Python programs with conditionals and loops.
- Define Python functions and call them.
- Use Python data structures –- lists, tuples, dictionaries.
- Do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Introduction to computers - characteristics - basic organization of a computer – algorithms - building blocks of algorithms (instructions/statements, state, control flow, functions) - notation (pseudo code, flow chart, programming language) - algorithmic problem solving - simple strategies for developing algorithms (iteration, recursion).

UNIT II DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW 9

Python interpreter and interactive mode - values and types - data types – variables – keywords - expressions and statements - python I/O - operators - precedence of operators – comments. Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else) – nested conditional. Iteration: while – for - break – continue – pass. Illustrative programs: exchange the values of two variables - circulate the values of n variables - test for leap year.

UNIT III FUNCTIONS 9

Function calls – type conversion – math function – composition - definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion. Strings: string slices – immutability - string functions and methods - string comparison. Illustrative programs: square root – GCD – exponentiation - sum the array of numbers - linear search - binary search.

UNIT IV COMPOUND DATA: LISTS, TUPLES AND DICTIONARIES 9

Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value.Dictionaries: operations and methods – dictionaries and tuples – dictionaries and lists. Advanced list processing - list comprehension. Illustrative programs: Sorting.

UNIT V FILES, MODULES AND PACKAGES 9

Files and exception: file operation - text files - reading and writing files - format operator- command line arguments - errors and exceptions - handling exceptions – writing modules – packages. Illustrative programs: word count - copy file – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python programs.

TEXT BOOK:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

REFERENCES:

1. Anita Goel, Ajay Mittal, Computer Fundamentals and programming in C, Pearson India Publisher, First edition, 2013.
2. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd. 2015.
5. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
6. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
7. The Python Tutorial, https://docs.python.org/2.7/tutorial/

GE17152 ENGINEERING GRAPHICS L T P C

2 0 4 4

OBJECTIVES:

The student should be able to:

- Develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- Expose them to existing national standards related to technical drawings.
- Study different type of projections, and practice him on free hand sketching.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves- Construction of helical curve.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL:90 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Do the conic curves and special curves.
- Do orthographic projection of lines and plane surfaces.
- Draw projections, solids, and development of surfaces.
- Prepare isometric and perspective sections of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., Engineering Drawing, Charotar Publishing House, Fiftieth Edition, 2010.
2. Natrajan K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R., Engineering Drawing (Vol.I&II combined), Subhas Stores, Bangalore, 2007.
3. Luzzader, Warren.J. and Duff,John M., Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, 2008.
5. Shah M.B., and Rana B.C., Engineering Drawing, Pearson, Second Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to end semester Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE17161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

The student should be able to:

- Be familiar with the use of office package, exposed to presentation and visualization tools.
- Implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Search, generate, manipulate data using Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem Solving using Algorithms and Flowcharts
4. Compute the GCD of two numbers.
5. Find the square root of a number (Newton‘s method)
6. Exponentiation (power of a number)
7. Linear search and Binary search
8. First n prime numbers
9. Find the maximum of a list of numbers
10. Sorting
11. Removing all the duplicate elements in a list
12. Multiply matrices
13. Programs that take command line arguments (word count)
14. Find the most frequent words in a text read from a file
15. Mini Project

TOTAL: 60 PERIODS

PLATFORM NEEDED:

Hardware: PC with 8 GB RAM, i3 Processor
Software: Python 3 interpreter for Windows/Linux

OUTCOMES:

At the end of the course, the students will be able to:

- Develop documentation, presentation and visualization charts.
- Implement Python programs with conditionals and loops.
- Develop Python programs stepwise by defining functions and calling them.
- Use Python lists, tuples and dictionaries for representing compound data.
- Read and write data from/to files in Python

GE17162 PHYSICS AND CHEMISTRY LABORATORY L T P C
0 0 4 2

OBJECTIVE:
The student should be able to:
- Introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)
1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fibre.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:
At the end of the course, the students will be able to:
- Apply the principle of elasticity vs Young's modulus & rigidity modulus of Engineering materials.
- Apply the principle elasticity in determining compressibility of liquids using ultrasonic waves.
- Apply the principle of optics in fiber optical communication.
- Apply thermal properties of various insulating materials in engineering applications.
- Use the basic instruments like vernier caliper, micrometer and microscope for various basic measurements.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:
The student should be able to:
- Acquire practical skills in the determination of water quality parameters.
- Gain the knowledge about spectrophotometer and flame photometer.
- Acquire knowledge on the determination of corrosion rate.

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 Experiments)
1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid vs strong base.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Estimation of copper content of the given solution by Iodometry.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Corrosion experiment-weight loss method.

TOTAL: 30 PERIODS

OUTCOMES:
On completion of the course, students will be able to:
- Apply the quantitative chemical analysis of water quality related parameters.
- Analyse characteristics of water.
- Measure the corrosion rate in metals.
- Apply instrumentation skills in analysing metallic elements in water.
- Analyse quantitatively the strength of acids and bases in water.

TEXT BOOKS:
Vogel's Textbook of Quantitative Chemical Analysis Eighth edition, 2014

HS17251 TECHNICAL ENGLISH L T P C
3 0 0 3

OBJECTIVES:
- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I Introduction Technical English 9
Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from journals-newsapapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations.Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II Reading and Study Skills 9
Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabulary used in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III Technical Writing and Grammar 9
Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations. Reading – longer texts both general and technical, practice in speed reading. Writing- Describing a process, use of sequence words. Vocabulary Development- sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV Report Writing 9
Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation(via email and hard copy)- analytical essays and issue based essays. Vocabulary Development-finding suitable synonyms-paraphrasing. Language Development- clauses- if conditionals.

UNIT V Group Discussion and Job Applications 9
Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases Language Development- reported speech, common errors in English.

TOTAL :45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.
- Write error free language.

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007.
6. Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

HS17252 PROFESSIONAL ENGLISH COMMUNICATION L T P C
3 0 0 3

OBJECTIVES

- To prepare students to be competent in a global business environment.
- To think accurately, clearly and deeply in communicative contexts.
- To improve career opportunities – get English language skills that are needed to be successful.

UNIT-I CRITICAL/ INFORMATIONAL LISTENING 9

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview(two or more speakers).

UNIT-II CONVERSATIONAL / PRESENTATION SKILLS 9

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT-III INTENSIVE/ EXTENSIVE READING AND INTERPRETING 9

Short texts (signs, messages, emails, labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper- magazine or article- reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT-IV FORMAL COMMUNICATION 9

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT – V VERBAL ABILITY/ FUNCTIONAL GRAMMAR **9**

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning - usage match.

TOTAL 45 PERIODS

OUTCOMES

On completion of the course students will be able to

- Listen to, understand and give opinions in meetings.
- Apply for new jobs and develop their career.
- Write short business messages and reports.
- Use language in both official and unofficial contexts.
- Speak effectively in business communication

TEXT BOOK:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

REFERENCE BOOKS:

1. Hartley, Mary. ―The Power of Listening,‖ Jaico Publishing House; First Edition (2015).
2. Chambers, Harry. ―Effective Communication Skills for Scientific and Technical Professionals,‖ Persues Publishing, Cambridge, Massachusetts, 2000.
3. Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. ‖Business Communication,‖ Eleventh Edition, Tata McGraw Hill Education Private Limited.

MA17251 ENGINEERING MATHEMATICS – II **L T P C**

Common to all branches of B.E.B.Tech.programmes **3 2 0 4**

OBJECTIVES *:*

- To handle practical problems arising in the field of engineering and technology.
- To solve problems using the concept of Differential Equation, Vectors calculus, Complex analysis, Laplace transforms.

UNIT I DIFFERENTIAL EQUATIONS **15**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

UNIT II VECTOR CALCULUS **15**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and application in evaluating line, surface and volume integrals (cubes and parallelepipeds).

UNIT III ANALYTIC FUNCTIONS **15**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, cz, $\frac{1}{z}$, z^2 - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION **15**

Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS **15**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 75 PERIODS

OUTCOMES:

On completion of the course students will be able to:

- Apply various techniques in solving differential equations.
- Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
- Evaluate line, surface and volume integrals using Gauss, Stokes and Green‘s theorems and their verification.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., ― Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O‘Neil, P.V. ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, ―Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., ―Advanced Engineering Mathematics –Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH 17253 PHYSICS OF MATERIALS L T P C

(Common to B.Tech. Chemical Engineering and Biotechnology) 3 0 0 3

OBJECTIVE:

- To introduce and study of synthesis and characterization of materials.
- To study the properties of conducting materials, superconductors, insulators, magnetic materials, ceramics and new materials.

UNIT I PREPARATION AND PROCESSING OF MATERIALS 9

Phases - Phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions – diffusion Fick's law - Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – Thin films – preparation: PVD method - Sol-gel method – heat treatment and hardening processes.

UNIT II PROPERTIES OF CONDUCTING AND SUPER CONDUCTING MATERIALS 9

Classical free electron theory of metals – expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - electrons in a metal: particle in a box (in three dimension) - Density of energy states – effect of temperature on Fermi energy – carrier concentration in metals - Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III ELECTRONIC MATERIALS 9

Elemental and compound semiconductors - Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – LED and Solar cells.

UNIT IV INSULATING AND MAGNETIC MATERIALS 9

Dielectric, paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of ClausiusMosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials. Magnetic bubbles.

UNIT V CERAMIC AND NEW MATERIALS 9

Introduction to Ceramics and its applications - Ceramic Fibres – role of matrix and reinforcement - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys – Relaxor- Ferroelectric materials – Electro and magneto rheological fluids - Sensors and Actuators – polymer semiconductos – photoconducting polymers –Bio-sensors - Bio materials – hydroxyapatite – PMMA – Silicone.

TOTAL : 45 PERIODS

OUTCOMES

On completion of the course, students will be able to

- Prepare and characterize the structure of various crystals.
- Analyze conducting properties of metals and superconductors.
- Analyze physical properties of semiconductors in electronic devices.
- Analyze the properties of insulating and magnetic materials.
- Analyze the usage of new engineering materials.

TEXT BOOKS

1. Raghavan. V. Materials Science and Engineering, Prentice Hall of India, 2002.
2. Palanisamy.. P.K., Materials Science, Scitech., 2003.

REFERENCES

1. Kumar.J, MoorthyBabu. S and Vasudevan. S., Engineering Physics, Vijay Nicole Imprints, 2006
2. Calister, W.D., Materials Science and Engineering an Introduction, John Wiley, 2003.
3. Raghavan, V., Physical Metallurgy, Prentice Hall of India, 2002
4. S. O. Pillai, Solid state physics, New Age International, 2015.
5. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2005.

CY17202 BIOORGANIC CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To understand bonding and stereo chemistry of organic molecules.
- To study the mechanism of addition and substitution reactions.
- To understand the kinetics of catalyzed bioorganic reactions.
- To study the functions of coenzymes and proton transfer reaction
- To understand the synthesis of biomolecules.

UNIT I BONDING AND STEREOCHEMISTRY 9

Atoms, electrons and orbitals - covalent bonds - octet rule - polar covalantbonds - electronegativity- formal charge - resonance -acids and bases - Arrhenius and Bronsted Lowry theories - acid base equilibria - sp^3 hybridization - conformation analysis - ethane, butane and cyclohexane –cis- trans isomerism. Stereochemicalactivity around the tetrahedral carbon – optical activity

UNIT II MECHANISMS OF SUBSTITUTION AND ADDITION REACTIONS 9

SN_1 and SN_2 reactions on tetrahedral carbon- nucleophiles- mechanism and steric effects – nucleophilicaddition on acetals and ketals -aldehyde and ketone groups – reactions of carbonyl group with amines- acid catalyzed ester hydrolysis – saponification of an ester- hydrolysis of amides-ester enolates – claisen condensation – michael condensation.

UNIT III REACTIONS AND CATALYSIS 9

Kinetics and Energetics of reactions – transition state theory and arrhenius equation – reactivity and catalysis – intra molecular reactions – metal ion catalysis - carbonic anhydrase and carboxypeptidase A – Covalent catalysis – Catalysis by organized aggregates and phases.

UNIT IV COENZYMES 9

Coenzymes (NAD + , FAD, PLP, CoA, Cobalamine, THF, Biotin, Lipoic acid) – acyl group transfer – C-C bond formation and fission – catalysis of proton transfer reactions – transfer of hydride ion – alkyl group transfer.

UNIT V BIOORGANIC REACTIONS 9

Microscopic reversibility – kinetic and thermodynamic control – thermodynamics of coupled reactions - timing of bond formation and fission – terpenebiosynthesis – merrifield solid state peptide synthesis - conformation of the peptide bond – sanger method for peptide and DNAsequencing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course students will be able to:

- Get familiarized with the bonding and stereo chemistry of bioorganic molecule.
- Distinguish between substitution and addition reactions of various functionalities.
- Describe the kinetics and energetics of catalyzed organic reactions.
- Apply the role of Coenzymes in bioorganic molecules.
- Identify synthetic strategies for peptides.

TEXT BOOKS

1. Carey, Francis A.‖Organic Chemistry‖.VII Edition, Tata MCGraw Hill, 2009.Page, M.I. and Andrew Williams ‗Organic and Bio-organic Mechanisms‖. Pearson, 2010.

REFERENCES

1. Dugas, Hermann ‗Bioorganic Chemistry : A Chemical Approach to Enzyme Action‖ 3rd Edition, Springer, 2003.

2. Morrison and Boyd, *Organic Chemistry* 6th Edition, 1992.
3. Finar, I.L., *Organic chemistry*. Vol-2, 5th edition, 1952.
4. Kalsi.P.S and Jagtap.S*Pharmaceutical, Medicinal and Natural Product Chemistry*, NarosaPublishing house, New Delhi, 2013.
5. John McMuray, 2nd edition.,*Organic Chemistry with biological applications*, Texas, Thomson Brooks/Cole. 2011.

ME17251 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart basic knowledge on Civil and Mechanical Engineering.
- To explain the materials used for the construction of civilized structures.
- To understand the fundamentals of construction of structure.
- To explain the component of power plant units and detailed explanation to IC engines their working principles.
- To explain the R & AC system.

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 07

Surveying: Objects – types – classification – principles– measurements of distances – angles – Leveling – determination of areas – illustrative examples. Civil Engineering Materials: Bricks – Stones – sand – cement – concrete – steel sections.

UNIT II COMPONENTS AND STRUCTURES 08

Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick Masonry – stone masonry – beams – columns – lintels – roofing – flooring - plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TOTAL: 15 PERIODS

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 10

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydroelectric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working Principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV I C ENGINES 10

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and Absorption system – Layout of typical domestic refrigerator – Window and Split type room Air Conditioner.

TOTAL: 30 PERIODS

COURSE OUTCOMES

- At the end of this course students can
- Able to explain the usage of construction material and proper selection of construction Materials.
- Able to design building structures.
- Identify the components used in power plants.
- Demonstrate working principles of petrol and diesel engine
- Understand and explain the components of refrigeration and air conditioning cycle.

TEXT BOOKS:

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 1996.
2. Gopalakrishnan K R, "Elements of Mechanical Engineering" Subash publishers Bangalore 2014.

REFERENCES:

1. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. 1999.
2. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
3. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.

BT17201 BIOCHEMISTRY L T P C
3 0 0 3

OBJECTIVES

The objectives of this course is to enable the students to understand

- The chemical basis of life which involves the importance of water, biological buffers and biomolecules
- The structure, properties of biomolecules involved in biochemical reactions.
- The role of enzymes in metabolism and to study their kinetics.
- Intermediary metabolic reactions and their regulation.
- Energy production from biomolecules

UNIT I INTRODUCTION TO BIOMOLECULES 9

Basic principles of organic chemistry - role of carbon - types of functional groups - overview of biomolecules and biochemical reactions - chemical nature of water - pH-Henderson Hasselbalch equation and biological buffers.

Carbohydrates: (mono, di - oligo& polysaccharides) - mutarotation, glycosidic bond - epimers, anomers and asymmetric nature of carbon - reactions of monosaccharides and reducing sugars.

Lipids: Classification- structure and properties- fatty acids – glycerol – saponification – iodination – hydrogenation – phospholipids – glycolipids – sphingolipids – cholesterol – steroids - prostaglandins.

UNIT II STRUCTURE AND PROPERTIES OF PROTEINS AND NUCLEIC ACIDS 9

Amino Acids: Structure and properties of amino acids - biologically significant peptides and proteins - hierarchy of organization of proteins primary - secondary, tertiary and quaternary structures of proteins – glycoproteins and lipoproteins.

Nucleic acids: Introduction to nucleic acids - Nucleic acids as genetic material - purines pyrimidines, nucleoside and nucleotide - structure and physicochemical properties of elements in DNA and RNA - biological significance of DNA and RNA - different between DNA and RNA - primary structure of DNA - chemical and structural qualities of 3',5'- phosphor diester bond - secondary structure of DNA - Watson & Crick model - Chargaff's rule - hyperchromic effect - nucleoprotein complexes.

UNIT III INTRODUCTIONTO ENZYMES 9

Introduction to metabolism - enzymes classification– structure (active site, substrate binding site) - role of coenzymes - regulation of enzyme activity (feedback, allosteric, covalent modification, proteolytic activation,synthesis and breakdown) - enzyme assays and units of expression – factors affecting enzyme activity- pH, temperature, substrate and enzyme concentration.

UNIT IV INTERMEDIARY METABOLISM AND ITS REGULATION 9

Introduction to metabolism -glycolysis - gluconeogenesis - pentose phosphate shunt -β oxidation of fatty acid- TCA cycle - reactions of amino acids - deamination, transamination and decarboxylation - urea cycle - interconnection of pathways and their regulation.

UNIT V BIOENERGETICS 9

Structure of mitochondria - general concept of oxidation and reduction - electronegative potential - high energy compounds - ATP/ADP cycle - electron transport chain - oxidative phosphorylation - uncouplers– inhibitors - - bioenergetics of glucose andpalmitic acid oxidation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students will be able to

- Understand the chemical basis of life which involves the importance of water, biological buffers and biomolecules.
- Comprehend the structure and functions of biomolecules.
- Cognize the action and regulations of enzymes.
- Relate the interconnection of different metabolic pathways.
- realizethe importance of ATP and other high energy compounds.

TEXTBOOKS:

1. Hames D, Hooper N., BIOS Instant notes - Biochemistry. 4th edition, GarlandScience,Taylor and Francis group, New York and London, 2011.
2. Pamela C Champe, Richard A. Harvey, Lippincott's illustrated reviews, Biochemistry, Third Edition, Lippincott Williams & Wilkins 2005.
3. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry. Appleton and Lange, Stanford, Conneticut, 30th Edition, McGraw Hill Education, February 2015.

REFERENCES:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry,6th edition, CBS publishers and distributors, 2012.
2. Burtis&Ashwood W.B. Tietz Textbook of Clinical chemistry, Volume 564, Saunders Company,1999.
3. LubertStryer W.H. Biochemistry, 5th Revised edition Freeman and company, New York, 2002.
4. Donald Voet& Judith G. Voet. Biochemistry. John Wiley and Sons, Inc. Rama Rao Textbook of Biochemistry, 4th Edition, Deb. Textbook of Biochemistry, November 2010.

GE17261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

a) (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) (b) Study of pipe connections requirements for pumps and turbines.

c) (c) Preparation of plumbing line sketches for water supply and sewage works.
d) (d) Hands-on-exercise:
    a. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
    b. (e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to fabricate carpentry components
- Ability to connect pipe connections including plumbing works.
- Ability to use welding equipment‘s to join the structures.

- Ability to fabricate electrical circuits
- Ability to fabricate electronics circuits.

BT17211 BIOCHEMISTRY LABORATORY L T P C

0 0 4 2

OBJECTIVES

- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules
- To perform proteins, carbohydrates, lipids and metabolites estimation
- To perform enzyme assays.

EXPERIMENTS

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement 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. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry‘s methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.Estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL HOURS: 60 HOURS

COURSEOUTCOMES:

Upon completion of the laboratory sessions, the students will be able to

1. Understand the basic principles of biochemical estimations and assays
2. Obtain practical knowledge in analysing various biomolecules both quantitatively and qualitatively
3. Gain knowledge in preparation of biomolecules
4. Aquire expertise in operation of analytical techniques
5. Learn various methods of enzyme assays needed for clinical research.

REFERENCES:

1. J.Jayaraman, Laboratory Manual in Biochemistry, 2nd Edition, New Age International Private Limited, January 2011.
2. S. K. Sawhney, Randhir Singh Eds, Introductory Practical Biochemistry, 5th or later edition, Narosa Publishing House, New Delhi, 2014.

BT17301 ENZYME TECHNOLOGY AND BIOTRANSFORMATIONS L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- Learn enzyme reactions and its characteristics along with the production and purification process.
- Basic knowledge concerning biotransformation reactions with the usage of enzymes.

UNIT I 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 and transition state theory – Role of entropy in catalysis.

UNIT II KINETICS OF ENZYME ACTION 9
Kinetics of single substrate reactions; estimation of Michaelis-Menten parameters – Multi- substrate reactions – Mechanisms and kinetics – Turnover number – Types of inhibition and models for substrate and product – Allosteric regulation of enzyme – Monod Changeux Wyman model – pH and temperature effect on enzymes & deactivation kinetics.

UNIT III ENZYME IMMOBILIZATION AND BIOSENSORS 9
Physical and chemical techniques for enzyme immobilization – Adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding and suitable examples – Advantages and disadvantages – Design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.

UNIT IV PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 9
Production and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes – Development of enzymatic assays.

UNIT V BIOTRANSFORMATION AND APPLICATIONS OF ENZYMES 9
Enzymes role in reduction reactions – Aldehydes, Ketones, Baeyer-Villiger Oxidation, Enzymes in organic synthesis – esters, amide, peptide – Modified and Artificial Enzymes – Catalytic antibodies, Application of enzymes in food, leather and pharmaceutical industry, Industrial applications of hyperthermophilic and psychrophilic enzymes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Students will gain knowledge on enzyme classification and enzyme reactions, a key step to proceed towards various concepts in biotechnology.
- Students will be able to understand the theoretical and practical aspects of kinetics, its importance and mode of utility of enzyme kinetics towards research
- Students will be able to comprehend the immobilization process which will help them to do simple and easy method of implementation in food ,pharmaceutical and chemical industries
- Students can develop confidence in performing enzyme purification, production from various biosources and enzymatic assays in future research studies
- Students will be able to get ideas on biotransformation reactions and production of novel enzymes at an industrial scale that will be helpful to work technologically.

TEXT BOOKS
1. Trevor Palmer , Enzymes IInd Horwood Publishing Ltd
2. Faber K , Biotransformations in Organic Chemistry, IV edition , Springer

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.

BT17302 BASIC INDUSTRIAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course helps the students to gain knowledge about bulk production of commercially important modern bioproducts, industrial Enzymes, products of plant and animal cell cultures

UNIT I INTRODUCTION TO INDUSTRIAL BIOPROCESS 10

Introduction, industrial products from plant, animals and micros, bioprocess and fermentation technology.Modern Biotechnology- Fermentor and its types, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, outline of genetic engineering and modern product development,process flow sheeting – block diagrams.

UNIT II PRODUCTION OF PRIMARY METABOLITES 8

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols.

UNIT III PRODUCTION OF SECONDARY METABOLITES 8

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids.

UNIT IV PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 11

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers. Cheese, Beer, SCP & Mushroom culture, Bioremediation, fermented foods.

UNIT V PRODUCTION MODERN BIOTECHNOLOGY PRODUCTS 8

Principal of recombinant technology, production of recombinant proteins having therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the above course, students will be able to:

- Carryout the steps involved in the production of bioproducts and methods to improve modern biotechnology.
- Identify commercially important primary metabolites and its production.
- Knowledge on production and recovery of antibiotics.
- Production of commercially important enzyme and its use.
- Identify the recombinant proteins used for therapeutic and diagnostic application.

TEXT BOOKS

1. Satyanarayana, U. ―Biotechnology‖ Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. ―A Textbook on Biotechnology‖ IInd Edition. Affiliated East West Press Pvt. Ltd., 1998.
3. Balasubramanian, D. etal., ―Concepts in Biotechnology‖ Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen ―Basic Biotechnology‖ IInd Edition Cambridge University Press, 2001.
5. Dubey, R.C. ―A Textbook of Biotechnology‖ S.Chand & Co. Ltd., 2006.

REFERENCES

1. Casida, L.E. ―Industrial Microbiology‖, New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, ―Industrial Microbiology‖, Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, ―Biotechnology: A Textbook of Industrial Microbiology‖, IInd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, ―Comprehensive Biotechnology‖, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. Stanbury, P.F., A. Whitaker and S.J. Hall ―Principles of Fermentation Technology‖, IInd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
6. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
7. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications

BT17303 INSTRUMENTAL METHODS OF ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

The course aims to develop the skills of the students in the area of Instrumentation in Biotechnology. This will be prerequisite for understanding specialized courses & project work that will be offered in the subsequent semesters.

UNIT I INTRODUCTION TO SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer‘s law – Instrumentation - Applications – Turbidometric and Nephalometric titration - Theory of Luminescence, fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III SEPARATION METHODS 9

General description of chromatography – ideal separation and stationary phases - Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography - Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography-principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT IV MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY 9

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer.Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT V THERMAL ANALYSIS AND SURFACE STUDY 9

Thermogravimetric Analysis - Derivative thermogravimetric analysis - Differential Thermal Analysis - Differential Scanning Calorimetry. Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will

- gain knowledge on principle of spectrometry and the optical instruments used for that..
- able to gain knowledge about the theoretical and practical aspects of molecular spectroscopy
- able to comprehend different separation methods are used in Biotechnology.
- develop knowledge of NMR and Mass Spectrometry and apply for future experiments.
- gain knowledge on different Microscopy.

TEXT BOOKS

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch ―Instrumental Methods of Analysis‖. CengageLearning , 2007.
2. Willard, Hobart, etal., ―Instrumental Methods of Analysis‖. VIIth Edition, CBS, 1986.
3. Braun, Robert D. ―Introduction to Instrumental Analysis‖. Pharma Book Syndicate, 1987.
4. Ewing,G.W. -Instrumental Methods of Chemical Analysis‖, Vth Edition, McGraw-Hill, 1985

REFERENCES

1. Sharma, B.K. ―Instrumental Methods of Chemical Analysis : Analytical Chemistry‖ Goel Publishing House, 1972.
2. Haven, Mary C., etal., ―Laboratory Instrumentation ―. IVth Edition, John Wiley, 1995.

BT17304 CELL BIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the structure and functions of cells and their organisation into tissues
- To acquire knowledge in the area of transport of ions and the mechanism of transmission of nerve impulses
- To analyse the various modes of communication between cells
- To study the types of cell division and its role in carcinogenesis
- To understand the techniques applied in cell research

UNIT I CELL STRUCTURE AND FUNCTION OF THE ORGANELLES 9

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cytoskeletal proteins. Extra cellular matrix, cell junctions.

UNIT II TRANSPORT ACROSS BIOLOGICAL MEMBRANES 9

Active, passive transport (simple diffusion, facilitated diffusion, glucose transport, anion exchanger), ATP powered pumps – Na^+/K^+ pumps, Ca^{++} pumps – significance, structure and mechanism of transport, secondary active transport, uniport, symport, antiport, exocytosis and endocytosis. Resting potential, action potential, conduction of nerve impulses, neurotransmitters. Ligand gated (acetyl choline) / voltage gated ion channels (Na^+, K^+, Ca^{++}).

UNIT III SIGNAL TRANSDUCTION 9

Cytosolic, nuclear and membrane bound receptors, examples of receptors, autocrine, paracrine and endocrine models of action, role of second messengers in cell signalling (cyclic AMP, cyclic GMP, IP_3, DAG, Ca^{++}, pathways), Ras/MAPK pathway, steroid hormone and thyroxine signalling.

UNIT IV CELL DIVISION, APOPTOSIS AND CANCER 9

Mitosis, Meiosis, Cell cycle and its regulation, molecules controlling cell cycle – cyclins CDKs, CDKIs, check points, cell survival and apoptosis pathways in relation to cancer.

UNIT V TECHNIQUES USED TO STUDY CELLS 9

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM, Fluorescent and Confocal Microscopy. Localization of proteins in cells – Immunostaining.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will be able to

- apply knowledge in the area of cellular organisation
- analyse the modes of transport and relate the same to function of nervous system
- examine the methods of communication within the cells
- correlate the basic concepts of cell division and their role in carcinogenesis
- design simple methods to analyse cell and their morphology

TEXT BOOKS

1. Lodish, Harvey etal., ―Molecular Cell Biology‖, Vth Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman ―The Cell : A Molecular Approach‖, IVth Edition, ASM Press, 2007.

REFERENCES

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry,6thedition, CBS publishers and distributors, 2012.
2. LubertStryer W.H. Biochemistry, 5thRevised edition Freeman and company, New York, 2002.

BT17305 STOICHIOMETRY AND FLUID MECHANICS L T P C
3 2 0 4

OBJECTIVES:

- This course aims at imparting knowledge about the basics of stoichiometric calculations, material and energy balances
- The students will learn the basic knowledge about the properties of fluids and fluid dynamics.

UNIT I INTRODUCTION 12

Dimensions – system of units - conversion factors - Compositions of mixtures and solutions - gas laws-humidity

UNIT II CONCEPTS IN MATERIAL BALANCES 12

Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, crystallization, drying, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration. Chemical Reaction-Limiting, excess component, Fractional conversion, Percent conversion, Fractional yield-Combustion Reactions.

UNIT III CONCEPTS IN ENERGY BALANCES 12

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change - thermo chemistry - Application of energy balance in Bioprocesses

UNIT IV FLUID PROPERTIES & FLUID MECHANICS 12

Fluid definition- fluid statics and its application – Boundary layer – Separation and wake formation - Fluid Dynamics – equation of continuity – Bernoulli‘s equation – Flow of incompressible fluids in pipes - Fluid flow measurement, Orifice, venturi and Rotameter.

UNIT V FLOW OF FLUID THROUGH PACKINGS 12

Drag, Flow through packed bed, Fluidization – Types – Applications, Pipe – Fittings and Valves, Pumps – Centrifugal pump and reciprocating pump, Fans, Blowers and Compressors.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

The students will learn

- Fundamentals of Units, dimensions and conversion factors.
- Solve material balances for different unit operations.
- Solve energy balance problems.
- Concepts of fluid statics and dynamics, fluid flow and its applications.
- Knowledge about valves, pumps and compressors and its application in industries.

TEXT BOOKS:

1. Bhatt, B.I. and S.M. Vora ‐Stoichiometry (SI Units)‖, 3rd Edition, Tata McGrawHill, 1996.
2. Geankoplis, C.J. ‐Transport Processes and Separation process Principles‖, 4th Edition, PHI, 2006.
3. McCabe, W.L., J.C. Smith and P. Harriot ―Unit Operations of Chemical Engineering‖, 6th Edition, Mc Graw Hill, 2001.

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1. Himmelblau, D.M. ‐Basic principles and calculations in Chemical Engineering‖, 6th Edition, PHI, 2006.
2. Foust, A.S. etal., ― Principles of Unit Operations‖, 2nd Edition, John Wiley & Sons, 1999.
3. Narayanan, K.V. and Lakshmi Kutty ―Stoichiometry and Process Calculations‖,PHI, 2006.
4. Coulson, J.M. and etal. ‐Coulson & Richardson‘s Chemical Engineering‖, 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier),2004.
5. Perrys Chemical Engineers Hand Book.

BT17311 INSTRUMENTAL METHODS OF ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

To train the students

- To have a practical hands on experience on Absoprtion Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analyse using spectrometric techniques
- Understanding principles of fluorescence spectroscopy

Experiments

1. Determination of precision and validity by using absorption spectroscopy.
2. Validation of Beer‘s-Lambert law by using $KMnO_4/K_2Cr_2O_7$
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)$_3$ and Fe (salicylate)$_3$ complex using absorption spectrometry.
4. Determination of the pKa value of 4-nitrophenol by using absorption spectrophotometer.
5. UV spectra and purity of DNA.
6. Estimation of SO_4^{2-} by nephelometry.
7. Estimation of Al^{3+} by using colorimeter
8. Absorption and emission spectra of aluminium-alizarin complex.
9. Separation of biomoleculesusing paper chromatography.
10. Separation of phytochemicals using column chromatography.
11. Reaction Kinetics usingspectrophotometry.

TOTAL : 60 PERIODS

COURSE OUTCOME:
The students would visualize and interpret the theory of spectroscopic methods by hands on experiments.

REFERENCES
1. Skoog, D.A. etal. ―Principles of Instrumental Analysis‖, Vth Edition, Thomson / Brooks – Cole,1998.
2. Braun, R.D. ―Introduction to Instrumental Analysis‖, Pharma Book Syndicate, 1987.
3. Willard, H.H. etal. ―Instrumental Methods of Analysis‖, VIth Edition, CBS, 1986.
4. Ewing,G.W. -Instrumental Methods of Chemical Analysis‖, Vth Edition, McGraw-Hill, 1985.

BT17312 CELL BIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES:
At the end of the course students will have in-depth knowledge about the various physiological and biological functions of the cell.
- To learn the various techniques in microscopy
- To learn about the trans port mechanism in the cell

Experiments
1. Introduction to principles of microscopy & parts of a microscope
2. Identification of given plant, animal and bacterial cells & their components by microscopy
3. Staining techniques – Leishman, Giesma Staining
4. Separation of Peripheral Blood Mononuclear Cells from blood
5. Osmosis and Tonicity
6. Tryphan Blue Assay
7. Staining for different stages of mitosis in AlliumCepa (Onion)
8. Thin Layer Chromatography – separation of plant pigments by TLC
9. Extraction of DNA from plant sources
10. Separation of mixtures using differential & isopycnic centrifugal techniques

TOTAL: 60 PERIODS

COURSE OUTCOMES:
- To learn the principles of cell propagation and sterilization
- To become familiar about the different staining methods for the identification of microbes.
- Ability to identify the different blood cells
- To gain knowledge on cell division.

REFERENCES
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.

HS17361 INTERPERSONAL AND SKILLS- LISTENING SPEAKING
Common to CSE, ECE, IT, MECH, BT, AUTO, CIVIL, MCT& BME
L T P C
0 0 2 1

OBJECTIVES:
The student should be able to:
- Upgrade the students‘ listening and speaking skills for educational purposes.
- Enhance the employability skills of the the students with a special focus on listening and speaking skills.

UNIT I INTRODUCTION 6

Importance of listening and Types of Listening – listening to TED Talks, lectures, etc. Speaking: group discussions on general topics like how to grow organic potted plants, to furnish an apartment inexpensively, etc. – Phonetics

UNIT II APPRECIATIVE LISTENING AND IMPROMPTU 6

Listening - Listening to motivational speeches, music and poetry. Speaking–pick and talk, short talks on any event on topics- a trip to remember, a job I'd love to have, etc. – Vocabulary: Collocation.

UNIT III INFORMATIVE LISTENING AND PERSUASIVE SPEAKING 6

Listening - Listening- to gather information such as facts, directions, news or instructions. Speaking – Persuasive speaking- convincing the audience with the speaker's view on the topics- food additives and unhealthiest, financial education is important in today's world, etc. – Vocabulary: Idioms and Phrases.

UNIT IV CRITICAL LISTENING AND SPEAKING ON SPECIAL OCCASION 6

Listening– Critical Listening- listening to examine and evaluate the message for logic and truth - televised debate, election campaign. Speaking –speech to commemorate a person or an event- speech of Introduction, etc. – Vocabulary: Foreign Words and Phrases.

UNIT V EMPATHETIC LISTENING AND DEMONSTRATIVE SPEAKING 6

Listening– Empathetic Listening – paying attention to another person with empathy – listening to problems and issues (videos).Speaking – Demonstrative speaking – Demonstrate a process using visual aids (charts, graphs, maps, pictures, etc.) – Grammar: Different types of Questions.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the different types of listening and speaking for effective interpersonal communication.
- Discuss and respond to content of a listening passage.
- Comprehend and answer questions based on the texts/passages given.
- Understand different genres of texts and comprehend the materials to improve their vocabulary and are familiar with new words, phrases, sentence structures and ideas.
- Make inferences and predictions about spoken discourse.

REFERENCES:

1. Meenakshi Raman and Sangeetha Sharma, Technical Communication – Principles and Practice, Second Edition, Oxford University Press, December, 2011.
2. Henry Lee, Interpersonal Skills: How to develop Interpersonal Skills for work and home, Kindle Edition
3. Erik Palmer, Teaching the Core Skills of Listening and Speaking , Kindle Edition

MA 17353	PROBABILITY AND STATISTICS	L T P C
	Common to Chemical, Biotech, BME & IT	**3 2 0 4**

OBJECTIVES

- To provide the required skill to apply the statistical tools in Engineering problems.

UNIT I ONE – DIMENSIONAL RANDOM VARIABLE 15

Discrete and continuous random variables – Moments – Moment generating functions –Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions – Functions of Random Variable.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 15

Joint distributions – Marginal and conditional distributions – Covariance – Correlation andLinear regression – Transformation of random variables – Applications of Central Limit Theorem.

UNIT III TESTING OF HYPOTHESIS 15

Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 15

One way and Two way classifications - Completely randomized design – Randomized blockdesign – Latin square design.

UNIT V STATISTICAL QUALITY CONTROL 15

Control charts for measurements (X and R charts) – Control charts for attributes (p,c and npcharts) – Tolerance limits - Acceptance sampling.

TOTAL :75 PERIODS

OUTCOMES

On completion of the course students will be able to

- Characterize standard probability distribution by employing basic techniques and methods of probability mass function and probability density function for discrete and continuous random variables
- Develop skills to solve problems on correlation and regression
- Obtain statistical data from experiments and able to analyze the same using statistical test.
- Design experiments using suitable ANOVA techniques and draw conclusions.
- Use control charts to study, analyze and interpret problems in statistical quality control.

TEXT BOOKS:

1. T. Veerarajan, ‗Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks' , Mc Graw Hill, 2016.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers.S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan.R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

CY17251 ENVIRONMENTAL SCIENCE AND ENGINEERING LTP C
3 0 0 3

OBJECTIVES:
The student should be able to:

- Find the scientific, technological, economic and political solutions to environmental problems.
- Study the interrelationship between living organism and environment.
- Study the importance of environment by assessing its impact on the human world.
- Study the dynamic processes and understand the features of the earth‘s interior and surface.
- Study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest ecosystem - grassland ecosystem - desert ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Significance of medicinal plants - biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition - causes, effects and control measures of Air pollution (Atmospheric chemistry - Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry- Mitigation procedures - Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) - Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance - Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards– e-Waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution – pollution case studies.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources - energy production from waste materials. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – Principles of green chemistry - nuclear accidents and holocaust, case studies – wasteland reclamation – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998

and amendments- scheme of labelling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards - disaster management: floods, earthquake, cyclone and landslides. Public awareness and case studies.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – Dengue fever- Swine flu – women and child welfare – Environmental impact analysis (EIA)- GIS-remote sensing - role of information technology in environment and human health – Case studies. Effect of Radiation from computing devices.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Solve problems that cannot be solved by mere laws.
- Get familiarized with ecological balance.
- Get public awareness of environment at infant stage.
- Find ways to protect the environment and play proactive roles.
- Develop and improve the standard of better living.

TEXT BOOKS:

1. Benny Joseph, Environmental Science and Engineering, Second edition, Tata McGraw-Hill, New Delhi, 2008.
2. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Second edition, Pearson Education, 2004.

REFERENCES :

2. Dharmendra S. Sengar, Environmental law, Prentice hall of India Pvt Ltd, New Delhi, 2007.
3. Erach Bharucha, Textbook of Environmental Studies , Third edition, Universities Press(I) Pvt, Ltd,Hyderabad, 2015.
4. G. Tyler Miller and Scott E. Spoolman, Environmental Science, Fifteenth edition, Cengage Learning India PVT, LTD, Delhi, 2014.
5. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Third edition, Oxford University Press,2015.

BT17401 CHEMICAL THERMODYNAMICS FOR BIOTECHNOLOGISTS

L T P C
3 0 0 3

OBJECTIVES:

To enable the students to learn

- Basic concepts and to solve the problems by using equations of state for estimation of thermodynamic properties.
- Derive the thermodynamic relations by using basic equations and understand the concept of partial molar properties and excess properties.
- Laws of thermodynamics in industries.

UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9

Scope of thermodynamics, fundamental concepts in thermodynamics, First Law of thermodynamics for flow and non-flow process, equations of state for real gases, estimation of thermodynamic properties using equations of state; Maxwell‘s relations and applications; residual properties.

UNIT II SOLUTION THERMODYNAMICS 9

Partial molar properties; determination of partial molar properties; Concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient-composition models; Gibbs Duhem equation.

UNIT III PHASE EQUILIBRIA 9

Criteria for phase equilibria; VLE calculations for binary and multi component systems; Bubble point, dew point calculations for VLE; consistency test for VLE data; Phase diagrams for binary solutions; Binaryliquid-liquid equilibrium diagrams.

UNIT IV CHEMICAL REACTION EQUILIBRIA 9

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant;Feasibility of reaction; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES 9

Concept of entropy; calculation of entropy changes;entropy and Irreversibility; Refrigeration-COP; Types of Refrigeration cycle-Vapor, Absorption and Air refrigeration; Liquefaction processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon success completion of this course, the students will be able to

- Solve the problems by using equations of state for estimation of thermodynamic properties.
- Derive the thermodynamic relations by using basic equations and understood the concept of partial molar properties and excess properties.
- Solve VLE calculations for binary liquid-liquid systems
- Solve problems on equilibrium conversions and yield for single, multicomponent systems.
- Calculation of the entropy for different processes and to learn the working principle of refrigeration cycle and liquefaction process.

TEXT BOOKS

1. Smith J.M., Van Ness H.C., and Abbot M.M. –Introduction to Chemical Engineering Thermodynamics‖, VIth Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. –A Text Book of Chemical Engineering Thermodynamics‖, PHI, 2003.

REFERENCE

1. Sandler S.I. –Chemical and Engineering Thermodynamics‖, John Wiley, 1989.

BT17402 UNIT OPERATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge on mixing and agitation operations and concepts of filtration.
- To introduce the basis of heat transfer mechanisms and learn about conduction in detail.
- To study mechanism of heat transfer by convection and various types of convection.
- To impart knowledge of various heat exchange equipments

UNIT I MIXING AND AGITATION 8

Dimensional analysis; power for agitation; agitation of liquids; gas-liquid systems; gas solid suspensions; agitator scale up.

UNIT II FILTRATION 8

Constant pressure, constant volume batch filtration; continuous filtration; industrial filters; settling and sedimentation; centrifugation.

UNIT III MECHANISM OF HEAT TRANSFER 10

Steady state conduction; combined resistances; unsteady state conduction; lumped heat capacity; extended surfaces; combined conduction and convection.

UNIT IV CONVECTION HEAT TRANSFER 10

Dimensional analysis; forced and natural convection; convection in flow over surfaces through pipes boiling and condensation.

UNIT V HEAT EXCHANGERS 9

Equipments; overall heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single effect; mass and enthalpy balances.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of Unit operations course graduates will be able to

- Identify, formulates, and solves engineering problem in Design of agitators.
- Apply knowledge of mathematics, science, and engineering for designing of filters.
- Use the techniques, skills, and modern engineering tools necessary for engineering practice in concept of conduction heat transfer.
- Design and conduct experiments on convection heat transfer.
- Apply the impact of engineering solutions in a global, eco-nomic, environmental, and societal context for design of heat exchangers , evaporators. and fermentors.

TEXT BOOK

1. Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.
2. McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. Mcgrawhill. 1993.

REFERENCE

1. Incropera F.P. Fundamentals Of Heat And Mass Transfer. John Wiley.1998

BT17403 FOOD BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To enable the students.

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

UNIT I FOOD AND NUTRIENTS 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 II 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, food adulterants and their detection, Introduction to food safety and security.

UNIT III 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 IV 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 V 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:

Through this subject the student will be able to:

- Describe the fundamentals of food processing and preservation
- Familiar with the functional properties of Carbohydrates, fats, lipids, proteins in food
- Knowledge about the importance of food additives and their function and will develop strategies that will promote food safety and prevent food borne illness
- Analyze the uses of enzymes, modified proteins and develop novel products, explain, analyze and evaluate scenarios related to various unit operations in food processing and preservation
- Identify spoilage and deterioration mechanism in food and methods to control deterioration and spoilage

TEXTBOOKS:

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society, London, 1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.

REFERENCES:

1. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., New York 1988.
2. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

BT17404 MICROBIOLOGY L T P C
3 0 0 3

OBJECTIVES:

At the end of the course the students would have gained knowledge about microbes history, Dyes, staining methods and methods of observation using different techniques in microscopy

- To gain knowledge on structural differences in microbes and their reproduction methods
- To learn the basic principles of bacterial culture and their nutritional requirements and methods to grow and counting methods to estimate the growth rate,also to learn the techniques of sterilization, interactions between microbes and their resistance power towards antibiotics and the technique to extract the ores using microbes

UNIT I INTRODUCTION TO MICROBIOLOGY 9

History (scientists and discoveries) and scope of microbiology (Primary and secondary metabolites), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light,

fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

UNIT II MICROBES- STRUCTURE AND REPRODUCTION 9

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, ʎ phage)

UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional classification of microorganisms based on carbon, energy and electron sources Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment, different media used for bacterial culture (defined, complex, selective, differential, enriched) the mathematics of growth-generation time, specific growth rate, biofilms and development.

UNIT IV CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration.Disinfection sanitization, antiseptics sterilants and fumigation.Determination of phenol coefficient of disinfectant. Host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms

UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY 9

Microbes involved in preservation (Lactobacillus,bacteriocins), spoilage of food and food bornepathogens *(E.coli, S.aureus, Bacillus, Clostridium*). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation(oil spillage leaching of ores by microorganisms, pollution control); biofertilizers, biopesticides. Biosensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will

- Apply depth Knowledge in different areas of Microbial research
- Transfer their Knowledge in developing techniques -Bacteria culture methods
- Apply the concepts of nutritional requirements and its metabolic pathways.
- working principles of different microscopes
- Industrial applications and also in extraction and remediation purpose.

TEXT BOOKS

1. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. ―General Microbiology.‖ 5th edition, McMillan Press. 1986
2. Ananthanarayanan, R. and C.K. JayaramPaniker, ―Textbook of Microbiology‖,4th Edition, Orient Longman, 1990.
3. Schlegel, H.G. ―General Microbiology‖, 7th Edition, Cambridge University Press, 1993.

REFERENCE BOOKS

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi,
2. Prescott L.M., Harley J.P., Klein DA, Microbiology, 3rd Edition, Wm. C. Brown Publishers, 1996.
3. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown

BT17411 CHEMICAL ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To develop skills of students by providing hands on training in some of the aspects of chemical engineering and unit operations

EXPERIMENTS

1. Flow measurement a) Orifice meter b) Venturimeter
2. Pressure drop flow in pipes
3. Pressure drop in flow through packed column
4. Pressure drop in flow through fluidized beds
5. Characteristics of centrifuge pump
6. Filtration in leaf filter
7. Shell and tube heat exchanger
8. Simple and steam distillation
9. HETP in packed distillation
10. liquid-liquid extraction
11. Adsorption isotherm
12. Diffusion
13. Leaching

TOTAL : 60 PERIODS

COURSE OUTCOMES:

The students will be able to

- Work on different types of fluid meters
- Handling of pumps and characteristics
- Carry out experiments on unit operations like distillation, extraction and adsorption
- Work on heat exchangers

REFERENCES:

1. Daniel R. Palleros, ‐Experimental organic chemistry‖ John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., ‐Vogel‘s Textbook of practical organic chemistry‖, LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel‘s R.C, ‐Text book of quantitative analysis chemical analysis‖, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.

BT17412 MICROBIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To learn the techniques in studying the microbes using microscopy
- To gain knowledge on culturing the microbes and identifying them using dyes
- To learn the ability of the microbes to grow in different conditions and the methods to control its growth against different disinfectants.

EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope

5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould/bacteria from food, soil and water samples
6. Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining, negative staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria
12. Identification of planktonic algae
13. Anaerobic culture: Roll tube method, Wright tube method
14. Biochemical study: Indole production test, methyl red test, urease test
15. Microscopic examination of protozoans
16. Cultivation of algae
17. Micrometery

TOTAL:60 PERIODS

COURSE OUTCOMES:

- To learn the basic principles of sterilization and cell propagation.
- To learn about the techniques for identification of microbes
- Ability to estimate the growth of the cells using different methods.
- Ability to find out the resistance power of microbe s using antibiotics.

TEXT BOOKS

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

HS17461	**ADVANCED READING AND WRITING**	**L T P C**
	COMMON TO CSE, IT, MECH, BT, CIVIL & AUTO	**0 0 2 1**

OBJECTIVES:

The student should be made to:

- Enhance the employability skills of the the students with a special focus on critical thinking, reading and writing.
- Enhance proficiency in the language and the ability to write compare and contrast essays effectively.

UNIT I PRIMITIVE READING AND FREE WRITING 6

Reading – Primitive Reading: Reading stories. Skimming: browse through a book or a long passage, understand the gist of a text. Writing: Free writing – writing about oneself/ family/ native/ hobbies/ festivals, etc. Grammar: Sentence Structure.

UNIT II SCANNING AND EXPOSITORY WRITING 6

Reading - Scanning: Guessing meaning from the context, surveying the text. Writing – Narrative Writing: Narrating a story, incident or past events. Grammar – Imperative Sentences.

UNIT III INTENSIVE READING AND DESCRIPTIVE WRITING 6

Reading – Intensive Reading: Drawing inferences from the text, responding critically to the text. Writing – Descriptive Writing: an incident, place, person, process, etc. Grammar – Different kinds of adjectives.

UNIT IV EXTENSIVE READING AND COMPARATIVE WRITING 6

Reading – Extensive Reading: Reading wide range of articles for better understanding, etc. Writing – Compare and Contrast: two things/ places/ persons/ ideas, etc. Grammar – Connectives.

UNIT V INFERENTIAL WRITING AND ARGUMENTATIVE/ PERSUASIVE WRITING **6**

Reading – Inferential Reading: draw upon prior knowledge, draw conclusions and make inferences. Writing – Argumentative and Persuasive Writing: establishing facts, forming and stating conclusions. Grammar – Conjunctions, Cohesive Devices.

TOTAL: 30 PERIODS

OUTCOMES

At the end of the course, the student should be able to:

- Skim through columns and magazines and write on simple topics with proper sentence structures.
- Read comprehensively and understand the thoughts of the writer and report clearly in detail about the happenings around.
- Comprehend and answer questions based on the texts/passages given and write descriptive essays.
- Read different genres of texts and comprehend the materials to improve their vocabulary and are familiar with new words, phrases, sentence structures and ideas.
- Read between lines, draw conclusions with their prior knowledge on the subject and persuade their readers with their flawless writing skills.

REFERENCES:

1. Bridge to College Success – Intensive Academic Preparation for Advanced Students – Robertson.
2. Source Work – Academic Writing from Sources Second Edition - Dellahite, Haun, Heinle / Cengage Learning, 2012.
3. Aebersold, Jo Ann and Field M. L. 1997, From Reader to Reading teacher, Cambridge, Cambridge University Press, Anderson, R. C. 1996.
4. Bamford, Julian and Day, R. R. 1997, Extensive Reading: What is it? Why Bother? Language Teacher Online.

BT17501 BIOPROCESS PRINCIPLES L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetics.

UNIT I OVERVIEW OF FERMENTATION PROCESSES **6**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

UNIT II RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS **10**

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

UNIT III STERILIZATION KINETICS **6**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment- batch and continuous.

UNIT IV METABOLIC STOICHIOMETRY AND ENERGETICS 12

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 V KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 11

Batch cultivation and continuous cultivation.Simple unstructured 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.Biomass estimation – Direct and Indirect methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course in Bioprocess Principles graduates will be able to

- Apply engineering principles to systems containing biological catalysts to meet the needs of the society.
- Convert the promises of molecular biology and genetic engineering into new processes to make bio-products in economically feasible way.
- Interpret the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes.
- Enhance and modify the biological materials to improve its usefulness by finding the optimal formulation materials to facilitate product production.

TEXT BOOKS

1. Shuler, Michael L. and Fikret Kargi, ―Bioprocess Engineering―, Prentice Hall, 1992.
2. Doran, Pauline ‐of Bioprocess Engineering Principles‐. Elsevier, 1995

REFERENCES

1. Lydersen, Bjorn K. ―Bioprocess Engineering Systems, Equipment and Facilities‖ John Wiley, 1994.
2. Bailey, James E. and David F. Ollis, ―Biochemical Engineering Fundamentals‖, IInd Edition. McGraw Hill , 1986.
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
4. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

BT17502 MASS TRANSFER OPERATIONS L T P C
3 0 0 3

OBJECTIVES:

- To define the principles of adsorption, absorption, leaching and drying extraction, distillation, crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I DIFFUSION AND MASS TRANSFER 9

Molecular diffusion in fluids and solids; Inter phase Mass Transfer; Mass Transfercoefficients; Analogies in Transport Phenomenon.

UNIT II GAS LIQUID OPERATIONS 9

Principles of gas absorption; single component absorption; Absorption withChemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTUconcepts.

UNIT III VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCabethiele method, Industrial distillation equipments.

UNIT IV EXTRACTION OPERATIONS **9**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, LeachingPrinciples.

UNIT V SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Batch and fixed bed adsorption; Drying-Mechanism-Dryingcurves-Time of Drying; Batch and continuous dryers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course the students will be able

- To demonstrate about gas -liquid, vapour- liquid and solid- liquid and liquid–liquid equilibrium.
- To classify and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process.
- To investigate a multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes (absorbers, strippers, and distillation columns) and sizing continuous separation units.
- To design and construction with operating principles of process economics of separating equipments

TEXT BOOKS

1. Treybal R.E. Mass Transfer Operations.3rd edition. McGraw-Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations.3rd edition, Prentice Hallof India, 2002.

REFERENCE

1. Coulson and Richardson‘s Chemical Engineering. Vol. I & II, Asian Books Pvt. Ltd,

BT17503 MOLECULAR BIOLOGY **L T P C**
4 0 0 4

OBJECTIVES:

- Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes. This will be needed for any project work in modern biotechnology.
- This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various

UNIT I CHEMISTRY OF NUCLEIC ACIDS **10**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3‘, 5‘-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff‘s rule, Conformational variants of double helical DNA, Hogsteen base pairing, Reversible denaturation and hyperchromic effect.

UNIT II DNA REPLICATION & REPAIR **10**

Overview of Central dogma.Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication.Mutagens, various types of repair mechanisms.

UNIT III TRANSCRIPTION 8

Structure and function of mRNA, rRNA and tRNA.Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Inhibitors of transcription, Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly _A' tail addition.

UNIT IV TRANSLATION 10

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis.Post-translational modifications and its importance.

UNIT V REGULATION OF GENE EXPRESSION 7

Organization of genes in prokaryotic and eukaryotic chromosomes, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle, Epigenetics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

By the end of this course, students should be able to:

- Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them;
- Identify the principles of DNA replication, transcription and translation and explain how they relate to each other.
- Discuss clearly about gene organization and mechanisms of control the gene expression in various organisms.
- Gain knowledge about the basic principle of translation.
- Gain knowledge on gene expression.

TEXT BOOKS:

1. Friefelder, David. -Molecular Biology.‖ Narosa Publications, 1999
2. Weaver, Robert F. -Molecular Biology‖ IInd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald ―Cell and Molecular Biology : Concepts and Experiments‖ IVth Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski ―Essentials of Molecular Biology‖ IInd Edition, Panima Publishing, 1993.

REFERENCES

1. Tropp, Burton E. -Molecular Biology: Genes to Proteins‖. IIIrd Edition. Jones and Bartlett, 2008.
2. Glick, B.R. and J.J. Pasternak. -Molecular Biotechnology : Principles and Applications of Recombinant DNA‖ 4th Edition. ASM, 2010.

BT17504 BIOINFORMATICS L T P C
3 0 0 3

OBJECTIVES:

The course aims to help students become comfortable using biological databases and bioinformatics techniques to solve biotechnological problem.

UNIT I 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 II **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 and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT III **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 modeling, abinitio approaches, Threading, Critical Assessment of Structure Prediction, Structural genomics.

UNIT IV **9**

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, Bioinformatics approaches for 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 V **9**

R programming language, input/output, control flow, file handling, different statistical functions and packages for biological data analysis eg: microarray data.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able

- To use biological databases and use DBMS systems to manipulate data
- To analyse sequence similarity
- To analyse evolution of genes and proteins using phylogeny and model protein structures
- To use machine learning approach to prediction methods
- To use R language in bioinformatics applications

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.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCE

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

BT17511 BIOPROCESS LABORATORY – I L T P C
0 0 4 2

OBJECTIVES:

- To educate the students on enzyme characterization, immobilization and medium optimization methods.
- To enhancethe students on methods to investigate the growth of microorganisms in different systems under different conditions.

EXPERIMENTS

1. Enzyme kinetics – Determination of Michaelis Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment/ Cross linking
6. Enzymatic conversion in Packed bed Column/Fluidized bed Column
7. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
8. Growth of Algae – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9. Medium optimization – Plackett Burman Design
10. Medium optimization – Response Surface Methodology

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, students will be able to:

- Explain about Enzyme kinetics and characterization and how to use them for practical applications.
- Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques.
- Determine an experimental objective, understand the theory behind the experiment, and operate the relevant equipment safely.
- Demonstrate good lab citizenry and the ability to work in team.

REFERENCES

1. Bailey and Ollis, ―Biochemical Engineering Fundamentals‖, McGraw Hill (2nd Ed.), 1986.
2. Shuler and Kargi, ―Bioprocess Engineering ―, Prentice Hall, 1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

BT17512 MOLECULAR BIOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To learn and understand the principles behind the cloning and expression of a gene
- To perform nucleic acid assays
- To learn the recombinant protein expression

Experiments

1. Isolation of bacterial DNA
2. Isolation of genomic DNA from plant
3. Agarose gel electrophoresis (preparation of butters, reagents for AGE)
4. Isolation of total RNA
5. Competent cells preparation & transformation

6. Blue and white selection for recombinants
7. Phage titration
8. Isolation of genomic DNA from animal tissue
9. Check the purity of DNA by using UV spectrophotometer
10. Isolation of genomic DNA from yeast

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the laboratory sessions, the students will be able to

- Clone and express a gene in a suitable host.
- Analyse nucleic acid molecules both quantitatively and qualitatively
- Gain knowledge in concept of genetic engineering
- create and express recombinant proteins.
- Produce genitically modified animals and plants.

REFERENCE

1. Sambrook, Joseph and David W. Russell ‐The Condensed Protocols: From Molecular Cloning: A Laboratory Manual‖ Cold Spring Harbor, 2006.

BT17513 BIOINFORMATICS LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To get qualified with programming knowledge.
- To enable the usage of bioinformatics tools.

LIST OF EXPERIMENTS

Basic UNIX commands

Types of Biological Databases and Using it.

Genbank.
Protein Data Bank.
Uniprot.
Pfam
CATH

Sequence Analysis Tools

Use of BLAST, FASTA (Nucleic Acids &Protiens).
Use of Clustal W.
Use of EMBOSS.

Phylogenetic Analysis

Use of Phyllip.

Molecular Modeling

Homology Modeling – Swissmodeller.

UCSC Genome Browser
Protein Pathway Analysis

Programming Languages: R for biological data analysis

TOTAL : 30 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able:

- To understand basic commands in UNIX OS.
- To use different biological databases.
- To carry out sequence and phylogenetic analysis.
- To use genome browsers
- To study protein interaction pathways

BT17601 BIOPHARMACEUTICAL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- The aim of the course is to give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development. This course provides core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I INTRODUCTION 9

Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses; and regulatory aspects .

UNIT II DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9

Route of drug administration, pharmacodynamics, pharmacokinetics – Absorption, Distribution, Metabolism and Excretion of drugs / metabolites, prodrugs, protein binding of drugs

UNIT III PRINCIPLES OF DRUG MANUFACTURE 9

Solid dosage forms – introduction to types of tablets, excipients, granulation techniques, compression machinery, processing problems, Coated tablets - types – enteric coated tablets, film coated tablets and sugar coated tablets. Evaluation of coated tablets. Production of hard and soft gelatine capsules, liquid dosage form – suspension and emulsion. Semisolid dosage form – ointment, GMP

UNIT IV CONTROLLED DRUG DELIVERY SYSTEMS 9

Concepts, Route of delivery - design of oral controlled drug delivery - dissolution controlled release system, diffusion controlled release system and oral osmotic pump. Parenteral controlled drug delivery – liposomes, osmotic pump (implants). Transdermal drug delivery.

UNIT V BIOPHARMACEUTICALS 9

Various categories of therapeutics like Laxatives, Analgesics, Contraceptives, Antibiotics, Hormones and Biologicals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students will be able to discover or develop a new drug with therapeutic value
- Students will know the basic principles of pharmacodynamics and pharmacokinetics
- Students will be able to isolate or produce drugs from different sources such as herbal plant, microorganism etc.
- Students will be able to prepare different types of formulations of drugs such as tablets, capsules , syrups etc.

- Students will be able to comprehend the pharmacodynamic and pharmacokinetics properties of different types therapeutic agents

TEXTBOOK

1. Finkel, Richard, etal., ―Lippincott's Illustrated Reviews Pharmacology‖ IVth Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.
2. D.M. Brahmankar, ―Biopharmacentics and pharmacokinetics‖ A treatise, 2005.

REFERENCES

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

BT 17602 BIOPROCESS TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- This course aims at imparting knowledge about the design of different types of bioreactors.
- The students will be able to scale up reactors and develop bioprocess models.

UNIT I OPERATIONAL MODES OF BIOREACTORS 10

Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors

UNIT II BIOREACTOR SCALE – UP 8

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 and impeller tip speed.

UNIT III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS 8

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 and membrane reactors

UNIT IV MODELLING AND SIMULATION OF BIOPROCESSES 12

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism.

UNIT V RECOMBINANT CELL CULTIVATION 7

Different host vector system for recombinant cell cultivation strategies and 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:

The students will learn

- Design of different types of reactors like Chemostat, packed bed, fluidized bed, airlift and bubble column reactors.
- Scale up reactors
- Design of immobilised enzyme bioreactors
- Analyze, develop and simulate bioprocess models.

- Knowledge in recombinant cell cultivation like animal cell, plant cell, insect cell and high cell density cultivation.

TEXT BOOKS

1. Shuler, Michael L. and Fikret Kargi, ―Bioprocess Engineering ―, Prentice Hall, 1992.
2. Doran M Pauline ‐Bioprocess Engineering Principles‖. 2 nd Edition, Elsevier, 2012.
3. Ghasem D.Najafpour, ―Biochemical Engineering and Biotechnology‖, Elsevier, 2007.

REFERENCES

1. Anton Moser, ―Bioprocess Technology, Kinetics and Reactors‖, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.
5. Shuler and Kargi, ―Bioprocess Engineering ―, Prentice Hall, 1992.
6. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

BT17603 GENETIC ENGINEERING L T P C
4 0 0 4

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, production of recombinant proteins and PCR techniques.
- To explain comparative genomics and proteomics.

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

DNA Manipulative enzymes, Linkers and Adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Prokaryotic and eukaryotic expression host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosome walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert‘s and Sanger Coulson‘s and automated methods of DNA sequencing, Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Touch down PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons, Site directed mutagenesis.

UNIT IV ORGANIZATION AND STRUCTURE OF GENOMES 9

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies. Genetic maps and Physicalmaps,Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT V CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Two hybrid System.

TOTAL:45 PERIODS

OUTCOMES:

- The students after completing this course would be aware of how to clone commercially important genes.
- The students would be able to produce the commercially important recombinant proteins.
- The students would be aware of gene and genome sequencing techniques.
- The students would have gained knowledge about microarrays, Analysis of Gene expression and proteomics.

TEXT BOOKS:

1. Primrose SB and R. Twyman ―Principles Of Gene Manipulation &GeneomicBlackwell Science Publications, 2006.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, Third Edition (Blackwell Publishing), 2003.
3. Gene cloning and DNA analysis by T.A Brown ,Sixth edition

REFERENCES:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, -Current Protocols In Molecular Biology ―Greene PublishingAssociates, NY, 1988.
2. Berger Sl, KimmerAR, ―Methods In Enzymology‖, Vol 152,Academic Press, 1987.
3. Genomes 3 by T.A.Brown, Third Edition (Garland Science Publishing)

BT17604 CHEMICAL REACTION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To impart the knowledge of reaction rate theories and reaction mechanisms to derive expressions for rate equations mass and energy balances.
- To provide a core foundation for the analysis and design of chemical reactors.

UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 9

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions.

UNIT II IDEAL REACTORS 9

Isothermal, batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems.

UNIT III IDEAL FLOW AND NON IDEAL FLOW 9

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9

Introduction – nature of catalyst, catalyst preparation - rate equation for surface kinetics; pore diffusion; effectiveness factor, thiele modulus; heat effects during reaction; progressive conversion module and shrinking core model.

UNIT V FIXED BED AND FLUID BED REACTORS 9

Trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The students will learn

- Different chemical Reactors, Rate equation of reactions.
- The basic principles and design conceptbehind the ideal reactors.

- Fundamentalideas about ideal flow and non-ideal flow reactors and also to develop flow models with residence time distribution.
- Depth knowledge about gas-solid,gas-liquid reactions and able to design reactors.
- Concept and operationalprinciples of fixed, slurry and fluidized type of reactors.

TEXT BOOKS:

1. Levenspiel O. Chemical Reaction Engineering. 3rd Edition. John Wiley.1999.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002

REFERENCE:

1. Missen R.W., Mims C.A., Saville B.A. Introduction To Chemical Reaction Engineering and Kinetics. John Wiley.1999

BT17611 BIOPROCESS LABORATORY II L T P C
0 0 4 2

OBJECTIVES:

- The course applies earlier learned knowledge about mass transfer in bio reactors and sterilization kinetics.
- Skills and knowledge gained is useful by analogy when solving problems typical for the bio industry or for research.

EXPERIMENTS

1. Batch Sterilization kinetics
2. Batch cultivation.
3. Estimation of KLa – Dynamic Gassing-out method,
4. Estimation of KLa – Sulphite Oxidation Method
5. Estimation of KLa – Power Correlation Method
6. Fed batch cultivation and Total cell retention cultivation
7. Algal cultivation-Photobioreactor
8. Residence time distribution
9. Estimation of Overall Heat Transfer Coefficient
10. Estimation of Mixing Time in reactor

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of this course,

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

REFERENCES

1. Anton Moser, ―Bioprocess Technology, Kinetics and Reactors‖, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Decker Inc.

BT17612 GENETIC ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Introduce students to the theory behind in each techniques and to describe common applications of each methodology in biological research.

EXPERIMENTS

1. Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Ligation of DNA into expression vectors
4. Transformation
5. Optimisation of inducer concentration for recombinant protein expression
6. Optimisation of time of inducer for recombinant protein expression
7. SDS-PAGE
8. Western blotting
9. Hybridisation with anti-sera
10. PCR.
11. Preparation of RNA by Trizol method

TOTAL :60 PERIODS

COURSE OUTCOMES:

By the end of this course, students should be able to:

- Describe the main principles, methods for preparation and cloning of DNA in various organisms.
- Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization, restriction analysis and gene expressions.
- Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.
- Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

REFERENCES

1. Old RW, Primrose SB, ―Principles Of Gene Manipulation, An Introduction To Genetic Engineering ‖, Blackwell Science Publications, 1993.
2. Ansubel FM, Brent R, Kingston RE, Moore DD, ―Current Protocols In Molecular Biology ―, Greene Publishing Associates, NY, 1988.
3. Berger Sl, Kimmer AR, ―Methods In Enzymology‖, Vol 152, Academic Press, 1987

BT17613 NUMERICAL PROGRAMMING FOR BIOTECHNOLOGISTS
L T P C
0 0 2 1

COURSE OBJECTIVES:

- To learn the MATLAB environment and its programming fundamentals
- Ability to write Programs using commands and functions
- Able to handle polynomials, and use 2D Graphic commands

LIST OF EXPERIMENTS

1. Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.
2. Data types, Constants and Variables, Character constants, operators, Assignment statements.
3. Input-Output functions, Reading and Storing Data.

4. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements.
5. Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations.
6. Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices.
7. Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials.
8. Graphics: 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart.

TOTAL :30 PERIODS

COURSE OUTCOMES:

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

- Sketch the fundamentals of MATLAB and the data analysis.
- Apply MATLAB programs to solve arithmetic operations on polynomials.

TEXT BOOK

1. Bansal.R.K, Goel.A.K, Sharma.M.K, ―MATLAB and its Applications in Engineering‖, Pearson Education, 2012.
2. Rudra pratap ―Getting Started with MATLAB‖ A Oxford University press, 2010.

REFERENCES

1. Amos Gilat, ―MATLAB-An Introduction with Applications‖, Wiley India, 2009.
2. Stephen.J.Chapman, ‖Programming in MATLAB for Engineers‖, Cengage Learning, 2011.

GE17451 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFT) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman.B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

BT17701 DOWNSTREAM PROCESSING L T P C
3 0 0 3

OBJECTIVES:

To enable the students to

- Gain knowledge about the methods to obtain pure proteins, enzymes and in general about product development R & D. Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion

UNIT I DOWNSTREAM PROCESSING 10

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses.Cell disruption for product release – mechanical, enzymatic and chemical methods.Pretreatment and stabilisation of bio-products.

UNIT II PHYSICAL METHODS OF SEPARATION 6

Unit operations for solid-liquid separation - filtration and centrifugation.

UNIT III ISOLATION OF PRODUCTS 12

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

UNIT IV PRODUCT PURIFICATION 12

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5

Crystallization, drying and lyophilization in final product formulation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Students will have in depth idea about downstream processing, Pretreatment and stabilization of bioproducts.
- Students will learn the basic principles of filtration and centrifugation.
- Students will be familiar with the fundamental ideas about Extraction and membrane separation techniques and will learn how to develop models for precipitation technique.
- Students will be able to work on chromatographic techniques and able to do Scaling up of chromatography.
- Students will know the fundamental concept and operational principles of Crystallization, Drying and Lyophilization and to do research.

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.
3. Asenjo, Juan A. ―Separation Processes in Biotechnology‖. CRC / Taylor & Francis, 1990.

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.

BT17702 IMMUNOLOGY 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 I INTRODUCTION TO IMMUNE SYSTEM 10

Organisation and classification of immune system – immune cells and lymphoid organs; innate and acquired immunity; immune response (HMI & CMI), classification of antigens – chemical and molecular nature; haptens, adjuvants; cytokines; antigen presenting cells; major histocompatibility complex

UNIT II T-CELL AND B-CELL BIOLOGY 10

Development, maturation, activation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, antibodies: structure and functions; antibodies: antigen-antibody reactions, complement pathways and function.

UNIT III IMMUNITY AGAINST PATHOGENS AND TUMORS 10

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; tumor antigens, mechanism of tumor immune response and tumor immunotherapy

UNIT IV IMMUNE TOLERANCE AND HYPERSENSITIVITY 8

Immune tolerance, Immuno deficiencies; Transplantation and graft rejection, Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Auto immune disorders and diagnosis

UNIT V APPLIED IMMUNOLOGY 7

Monoclonal antibodies, engineering of antibodies; immunization and vaccine, immunodiagnostic methods (Immuno diffusion ELISA, FACS), immuno modulatory drugs

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of course,

- Students will have a sound knowledge about the immune system and their role in disease protection
- Student will gain indepth knowledge about the development of mature lymphocytes in lymphodial organs
- Students acquired knowledge about the immune response against various pathogen and tumor antigen

TEXT BOOKS:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., XIIth edition 2011. 52
2. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

REFERENCES:

1. Coico, Richard ―Immunology: A Short Course‖ VIth Edition. John Wiley, 2008.
2. Khan, Fahim Halim ―Elements of Immunology‖ Pearson Education, 2009.

BT17703 PROTEIN ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- At the end of the course, the student would have learnt structure and function of
- proteins of particular importance, the student will know the production of recombinant insulin & in general how to engineer protein to be used as therapeutics.

UNIT I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 10

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, X-ray) 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 II PROTEIN ARCHITECTURE 10

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass-spec. Secondary structure: Alpha, beta and loop structures and methods to determine. Super-secondary structure: Alpha-turn-alpha, beta-turn-beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds.

UNIT III TERTIARY STRUCTURE 5

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: of proteins.

UNIT IV STRUCTURE-FUNCTION RELATIONSHIP 10

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, bacteriorhodopsin 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.

UNIT V PROTEOMICS 10

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The students can identify the difference in amino acids and understand basics of protein structure
- The students will be familiar about the folds and motifs of protein structure
- The students will be able to solve the ways and means to predict the structure of proteins
- The students will be able to comprehend the structure function correlation in proteins
- The students will be aware of importance of proteomic techniques.

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.

BT17711 DOWNSTREAM PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVES

To enable the students to

- Provide hands on training in Downstream Processing by through simple experimentation in the laboratory. This will be a pre-requisite for project work.

Experiments

1. Solid liquid separation – centrifugation, sedimentation, flocculation
2. Cell disruption techniques – ultrasonication
3. Precipitation – ammonium sulphite precipitation
4. Ultra filtration separation
5. Aqueous two phase extraction of biologicals
6. High resolution purification – affinity chromatography
7. High resolution purification – ion exchange chromatography
8. Product polishing – drying
9. High resolution purification – gel filtration
10. HPLC

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- Students will acquire knowledge for the separation of whole cells and other insoluble ingredients from the culture broth.
- Students get the ability to apply their knowledge for cell disruption and specify the techniques to release intracellular products
- Students can use the techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products.
- Students themselves able to apply the basic principles and techniques of chromatography to purify the biological products
- Students earns broad education in formulating the product which is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

REFERENCES

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – 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.

BT17712 IMMUNOLOGY LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To train the students to perform various immunology techniques and to interpret the results
- To provide basic skills and advances in the field of immunodiagnosis
- To train the students to handle the experiment animals for immunological research

EXPERIMENTS

1. Handling of animals, immunization and raising antisera
2. Identification of cells in a blood smear
3. Identification of blood group
4. Immunodiffusion & immunoelectrophoresis
5. Testing for typhoid antigens by Widal test
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of peripheral blood mononuclear cells
8. Coombs test
9. Haemagglutination test
10. Pregnancy test (HCG)
11. Preparation of serum and plasma from blood
12. Identification of t cells by T-cell rossetting using sheep RBC.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of course,

- Students acquired ability to design the experiments in immunology research laboratories
- Students have ability to handle the animals for immunological research
- Students will have ability to draw blood from intravenous source and to separate the serum
- Students will able identify the blood group the person
- Acquired the ability to rise antiserum against protein antigens by using experimental animals
- Acquired ability to perform and interpret the result of widal test (thypoid fever)
- Students able to isolate the PBMC and characterize

REFERENCES

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 2000.
3. Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998.

BT17E51 BIOPHYSICS L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To gain structural knowledge of biological systems.
- To understand transport and dynamic properties of biological systems.

UNIT I MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS 9

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures -general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II CONFORMATION OF NUCLEIC ACIDS 9

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure– the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT III CONFORMATION OF PROTEINS 9

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

UNIT IV CELLULAR PERMEABILITY AND ION – TRANSPORT 9

Ionic conductivity – transport across ion channels – mechanism - ion pumps- proton transfer – nerve conduction – techniques of studying ion transport and models.

UNIT V ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS 9

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able:

- To analyze the various forces responsible for biological molecular structure.
- To be familiar with different levels of conformation in biomolecules.
- To gain the knowledge of cellular permeability and ion transport.
- To understand the dynamics of biological systems.

TEXTBOOKS

1. Biophysics ; R. Glaser, Springer Verlag , 2000.
2. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCE

1. Cantror, Charles R. and Paul R. Schimmel ―Biophysical Chemistry‖ . 1-3 Vols. W.H.Freeman & Co.,1980.

BT17E52 SYMBOLIC MATHEMATICS L T P C
3 0 0 3

COURSE OBJECTIVES:
To enable the students,
- To gain knowledge about MATLAB and its operators and loops.
- To learn Programming techniques and data visualization.
- To apply the fundamentals of virtual instrumentation and data acquisition.

UNIT I INTRODUCTION TO MATLAB 9
Introduction - Operations with variables – Arrays - Multidimensional Arrays - Element by Element operations - Polynomial operations using arrays - Cell Arrays - Structure arrays - Writing script files - Logical variables and operators- Flow control- Loop operators- Writing functions- Input/ output arguments- Function visibility, path.- Simple graphics- 2D plots-Figures and subplots

UNIT II DATA AND DATA FLOW IN MATLAB 9
Data types- Matrix, string -cell and structure- Creating, accessing elements and manipulating of data of different types - File Input-Output- Matlab files- Text files- Binary files - Mixed text-binary files- Communication with external devices- Serial port- Parallel port- Sound card-Video input

UNIT III FUNCTIONS & FILES 9
Elementary Mathematical Functions - User Defined Functions - Advanced Function Programming - Working with Data Files, Introduction to Numerical Methods -Linear algebra-numerical integration and differentiation- solving systems of ODE‘s and interpolation of data.

UNIT IV PROGRAMMING TECHNIQUES & DATA VISUALIZATION AND STATISTICS 9
Program Design and Development - Relational Operators and Logical Variables Logical Operators and Functions - Conditional Statements -Loops - Basic statistical tools in Matlab,XY-plotting functions - Subplots and Overlay plots - Special Plot types - Interactive plotting - Designing GUI interfaces using Matlab‘s GUIDE interface.

UNIT V FUNDAMENTALS OF VIRTUAL INSTRUMENTATION & DATA ACQUISITION 9
Concept of virtual instrumentation (VI)– LabVIEW software- basics- Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts- data acquisition with LabVIEW-plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels- Driving the digital I/Os- Buffered data acquisition

TOTAL : 45 PERIODS

COURSE OUTCOMES:
The students would have gained knowledge
- To solve MATLAB programs and its operators and loops.
- To apply Programming techniques and data visualization.
- To apply the fundamentals of virtual instrumentation and data acquisition.

TEXT BOOKS:
1. Essential Matlab for Engineers and Scientists (Fourth Edition). Copyright © 2010 Elsevier Ltd. Author(s): Brian H. Hahn and Daniel T. Valentine ISBN: 978-0-12-374883-6
2. Rahman, and Herbert Pichlik,, _LabVIEW – Applications and Solutions‘, National Instruments Release, ISBN 01309642392. National Instruments LabVIEW Manual

ONLINE MATLAB TUTORIALS AND REFERENCES:

1. Tutorials offered by The Mathworks .The creators of Matlab.
2. Introductory Matlab material from Indiana University
3. A practical introduction to Matlab from Michigan Tec
4. Links to Matlab tutorials, references, books, packages, etc. - The Math Department at UIC

BT17E53 MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES

L T P C
3 0 0 3

OBJECTIVES:

- To learn about the key concepts of host defense against pathogens and bacterial defense strategies
- To gain sound knowledge about the molecular mechanism of virulence
- To learn the techniques of molecular approach to control the microbial pathogens

UNIT I OVERVIEW 5

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.

UNIT II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 8

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.

UNIT III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) 16

Bacterial secretion system in gram negative bacteria, *E.coli*, Enterotoxigenic *E.coli* (ETEC), Enterohaemerrohogi *E.coli* (EHEC). *Vibrio cholerae*: Choleratoxin, co-regulated pili, filamentous phage. Bacterial secretion system in gram positive bacteria, *mycobacterium tuberculosis* – transmission and pathogenesis. Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine, Tuberculosis.

UNIT IV EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS 8

Virulence, virulence factors, virulence - associated factors and virulence lifestyle factors molecular genetics and gene regulation in virulence of pathogens, virulence assays: biofilm formation and development, adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses. Antibiotic resistant mechanism in pathogens.

UNIT V MODERN APPROACHES TO CONTROL PATHOGENS 8

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immuno & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

- Describe the basic feature of pathogenesis and how microorganism involved in disease progress.

- knowledge about the host defense strategy against pathogens and bacterial defense strategies.
- Familiar with the molecular mechanism of virulence and the ability to perform the cause of bacterial infections.
- Study the basic knowledge about the host pathogen interactions.
- Learn different molecular techniques to control the mechanism of microbial pathogens.

TEXT BOOKS:

1.Iglewski B.H and Clark V.L – Molecular basis of Bacterial Pathogenesis –, Academic Press, 1990.
2.Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

REFERENCES

1. Peter Williams, Julian Ketley & George Salmond, ―Methods in Microbiology : Bacterial Pathogenesis, Vol. 27‖, Academic Press, 1998.
2. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
3. Nester, Anderson, Roberts, Pearsall, Nester, ―Microbiology: A Human Perspective‖, Mc Graw Hill, 3rd Edition, 2001.

BT17E54 CLINICAL BIOCHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To provide information about clinical changes in disorders of metabolic pathways
- To disseminate knowledge about hormone related disorders
- Gain knowledge about lifestyle diseases to protect ourselves
- To interpret laboratory data for proper diagnosis of diseases
- To design methods for the diagnosis and treatment of genetic diseases.

UNIT I DISORDERS OF METABOLIC PATHWAYS 9

Scope of clinical biochemistry.Disorders of carbohydrates, lipids, proteins and nucleic acid metabolisms (Sickle cell anenmia, Phenyl ketonuria, alkaptonuria, albinism, Nieman Pick disease, Glycogen storage diseases, Lesch-Nyhan Syndrome and Gout).Diabetes mellitus, clinical features, metabolic changes.Glycosuria, galactosemia and fructosuria.

UNIT 2 HORMONAL DISORDERS 9

Classification of hormones-Peptide hormone -vasopressin - protein hormone- insulin -Steroid hormones-testosterone, estrogen, cortisol – amino acid hormones -thyroxine, adrenaline, noradrenaline.Disorders of hormones.

UNIT 3 LIFE STYLE DISEASES 9

Type II Diabetes, Obesity, Artherosclerosis, Heart diseases, High blood pressure, Swimmer‘s ear,Cancer, Chronic obstructive pulmonary disease, Cirrhosis, Nephritis.

UNIT 4 CLINICAL DIAGNOSIS OF DISEASES 9

Composition of blood and urine in normal and disease conditions –their significance-urea, uric acid, Creatinine, Glucose, bilirubin, total protein, A/G ratio, lipid profile- total cholesterol, HDL, LDL. Organ function tests (liver, renal and gastric). Diagnostic enzymes and Biomarkers.\

UNIT 5BIOTECHNOLOGY AND HUMAN DISEASES 9

Restriction endonucleases- DNA cloning- probes- southern blotting- restriction fragment length polymorphism- polymerase chain reaction- analysis of gene expression- gene therapy- transgenic animals

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students will

- comprehend the abnormalities associated with metabolic pathwaysand hormonal disorders
- learn to protect against lifestyle disorders
- interpret laboratory data for proper diagnosis of diseases
- design methods for the diagnosis and treatment of genetic diseases.

TEXT BOOKS:

1. Richard A. H, Denise R. F, Lippincott‘s Illustrated Reviews: Biochemistry, Fifth Edition - Lippincott Williams & Wilkins
2. M.N. Chatterjee, Rane shinde, Text book of medical biochemistry Eighth Edition - JAYPEE publications
3. Alan H. Gowenlock, Varley‘s Practical Clinical Biochemistry, Sixth Edition- CBS Publisher

REFERENCE BOOKS

1. Carl A. Burtis, David E. Bruns, Edward R. Ashwood, Tietz Fundamentals of Clinical Chemistry, 6th Edition - Saunders Company.
2. Thomas M. Devlin, Textbook of Biochemistry with Clinical Correlations, 4th Edition - Wiley and Sons Ltd. 1997.
3. Salway, J.G., ‑Metabolism at a Glance‖. IInd Edition, Blackwell Science Ltd., 2000.

BT17E61 ANIMAL BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To develop the skills of the students in the area of animal biotechnology and its applications
- The student will learn about animal cell culture, molecular diagnostic of animal diseases and Transgenic animal production.
- This subject will facilitate the student to undertake project work in this area.

UNIT I ANIMAL CELL CULTURE 12

Basic tissue culture techniques, animal cell culture media – types, advantages and disadvantages of serum containing and serum free media. Animal cell cultures – primary culture, secondary culture, maintenance and preservation. Various types of cultures – mono layers, suspension cultures, continuous flow cultures, immobilized cultures. Somatic cell fusion, cell cultures as a source of valuable products and organ cultures.

UNIT II ANIMAL DISEASES AND THEIR DIAGNOSIS 10

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP.

UNIT III THERAPY OF ANIMAL DISEASES 12

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections.

UNIT IV MICROMANIPULATION OF EMBRYO’S 6

Micromanipulation technology – definition and equipments used in micromanipulation. Enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals.

UNIT V TRANSGENIC ANIMALS 5

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Develop a vaccine using cell culture
- Diagnose animal diseases using molecular tools
- Analyze the efficiency of different gene transfer methods
- Apply the use of different transgenic animals for different applications
- Pursue higher studies and do specialization in animal biotechnology

TEXT BOOKS

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

REFERENCE

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000

BT17E62 SYSTEMS BIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand overview of Systems Biology
- To provide knowledge onSystems Microbiology and Developmental Systems Biology
- To gain knowledge on Network Biology andapplications of Enzyme Kinetics
- To know different tools of Systems Biology and application.

UNIT I SYSTEMS BIOLOGY FUNDAMENTALS 9

Overview of Ssytems Biology-Overview of Gene Control-Gene Control Mechanisms at Transcription and Translation Levels-Genetic Switches-The Biochemical, Genetics and the Systems Biology Paradigm

UNIT II SYSTEMS MICROBIOLOGY & DEVELOPMENTAL SYSTEMS BIOLOGY 9

Quorum Sensing - The Language of Bacteria- Programmed Population control by Cell-cell Communication and Regulated killing-Drosophila melanogaster-Life Cycle-Drosophila melanogaster- Morphogen Gradient-Establishment of Developmental Precision and Proportions in the Early Drosophila Embryo.

UNIT III ENZYME KINETICS & NOISE IN GENE EXPRESSION 9

Enzyme Kinetics-.MichaelisMenten Kinetics- Binding and Cooperativity- Enzyme Inhibition-Identical Independent Binding Sites-Sequential Model of Cooperativity-Non-Identical, Interacting Binding Sites-The Structure and Genetic Map of Lambda phage-Noise and Gene Expression and Gene Regulatory Networks-The signalling pathway in chemotaxis.

UNIT I IV GENE EXPRESSION NETWORKS 9

Gene Expression Networks-Transcription Networks-Networks in Biology - Network Motifs-Feed Forward Loops in Biological Systems-Coherent and InCoherent Feed Forward Loops-Kinetics of CFFL-1- Sign Sensitive Delay-Kinetics of ICFFL-1- Sign Sensitive Accelerator.

UNIT V TOOLS FOR SYSTEMS BIOLOGY 9

Pathway mapping through KEGG, Cytoscape, Virtual Cell, Gene network using R.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To gain knowledge about Systems Biology and Network Biology.
- To provide knowledge onSystems Microbiology and Developmental Systems Biology
- Apply the knowledge in Enzyme Kinetics
- To work on different tools of Systems Biology and application.

TEXT BOOKS

1. EddaKlipp, Wolfram Liebermeister, ChristophWierling Axel Kowald, Systems Biology: A Textbook,Willey,2016
2. Hans Westerhoff (Editor), MalkheyVerma (Editor), Daniel Jameson. Methods in Systems Biology.

REFERENCES

1. AlpanRaval,Animesh Ray. Introduction to Biological Networks.Taylor and Francis Group. 2013.

BT17E63 BIOLOGICAL SPECTROSCOPY L T P C
3 0 0 3

OBJECTIVES:

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

UNIT I OPTICAL ROTATORY DISPERSION 5

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins.

UNIT II NUCLEAR MAGNETIC RESONANCE 10

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect– multidimensional nmr spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging.

UNIT III MASS SPECTROMETRY 10

Ion sources sample introduction – mass analyzers and ion detectors – bimolecular mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

UNIT IV X-RAY DIFFRACTION 10

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction.

UNIT V SPECIAL TOPICS AND APPLICATIONS 10

Electron microscopy – transmission and scanning electron microscopy – scanning tunneling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student would be able understand

- Basics of optical rotary dispersion methods and nuclear magnetic resonance
- Principles and applications of mass spectrometry and X-ray diffraction About the microscopic techniques and applications
- Apply the spectroscopic techniques for various biological applications

TEXT BOOKS:

1. Hammes G.G., ―Spectroscopy For The Biological Sciences‖, Wiley-Inter Science, First Edition, 2005.
2. Ramamoorthy A., ―NMR Spectroscopy Of Biological Solids‖, CRC Press, 2005.

REFERENCES:

1. Campbell I.D And Dwek R.A., ― Biological Spectroscopy ―, Benjami Cummins And Company, 1986.

2. Pretsch E., Bühlmann P. And Badertscher M., ―Structure Determination Of Organic Compounds: Tables Of Spectral Data‖, Springer, Fourth Edition, 2009.
3. Gremlich H. And Yan B., ―Infrared And Raman Spectroscopy Of Biological Materials‖, CRC Press, 2000.
4. Greve J., Puppels G.J. And Otto C., ―Spectroscopy Of Biological Molecules: New Directions Springer‖, First Edition, 1999.

BT17E64 FOOD PROCESSING, SAFETY AND QUALITY CONTROL

L T P C
3 0 0 3

OBJECTIVES:

On completion of the course the students are expected to

- Be aware of the different methods applied to processing foods.
- Be able to understand the significance of food processing
- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To be aware of the regulatory and statutory bodies in India and the world

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9

Source of food - food of plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods

UNIT II LARGE-SCALE FOOD PROCESSING 11

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT III INTRODUCTION TO FOOD SAFETY 12

Definition of food safety and concept of safe food; characterization of food hazards physical, chemical and biological; adulteration, filth, plastics, pesticides, heavy metals; Changes due to food processing, trans fatty acids, pyrolytic and thermal decomposition products, urethane, mycotoxins, scrombotoxin, migration, cross - contamination, nitrates and related products, sulfites, phenolic antioxidants, non-nutritive sweeteners, fat substitutes, chemical preservatives, veterinary drugs and antibiotics.

UNIT IV MONITORING AND REGULATION 6

HACCP, GMP; Surveillance networks, Consumer and food service operator education, function and roles of USFDA, USDA and EPA; Food Safety and Standards Act India 2006; Prevention of Food Adulteration Act, India, 1954; Responsibilities of the Food service operator, consumer protection, food audit

UNIT V STANDARDS FOR FOOD ANALYSIS 7

International Food Standards ISO 9000 and related 92 standards; Standards of identity, purity and methodology for analysis of: a) Cereals, legumes, oil seeds and their products; b) Fruits, vegetables, tubers and their products; c) Tea, coffee, cocoa, chocolate, spices, condiments; d) Milk and milk products; e) Meat, fish and poultry products; f) Miscellaneous foods e.g. fermented products.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course the students are expected to

• Be aware of the different methods applied to processing foods.

• Be able to understand the significance of food processing
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To be aware of the regulatory and statutory bodies in India and the world

TEXTBOOOKS

1. Sivasankar, B. ―Food Processing & Preservation‖, Prentice Hall of India, 2002.
2. Khetarpaul, Neelam, ―Food Processing and Preservation‖, Daya Publications, 2005.
3. Mehta, Rajesh and J. George ‗Food Safety Regulation Concerns and Trade : The Developing Country Perspective‖. Macmillan, 2005.

REFERENCES

1. Potter, Norman N., Hotchkiss, Joseph H. (1995), Food Science, 5th Ed. Springer US
2. Manay, S.; Shadaksharaswami, M., (2004). Foods: Facts and Principles, 4th Ed. New Age Publishers.
3. B. Srilakshmi., (2002), Food Science, New Age Publishers.
4. Meyer, (2004). Food Chemistry.New Age Publishers.
5. Deman JM. (1990) Principles of Food Chemistry. 2nd ed. Van Nostrand Reinhold, NY
6. Ramaswamy H and Marcott M. (2005), Food Processing Principles and Applications. CRC Press.
7. Lightbourne, Muriel ―Food Security, Biological Diversity and Intellectual Property Rights‖ Ashgate, 2009.

BT17E65 CANCER BIOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to know cell cycle dysregulation in cancer and various stages of carcinogenesis.
- To learn about the molecular basis of cancer and new treatment options for cancer patients

UNIT I FUNDAMENTALS OF CANCER BIOLOGY 9

Definition types – benign, malignant tumors, properties, grading, stages, regulation of cell cycle, mutations that cause changes in signal molecules, signalling pathways – growth factors, G proteins, Wnt, JAK-STAT, TGF-β, PI_3K/AKT, intrinsic and extrinsic apoptotic pathways, heredity and cancer.

UNIT II PRINCIPLES OF CARCINOGENESIS 12

Carcinogenesis – Theroies of carcinogenesis, classification and metabolism of chemical carcinogens mechanism of chemical carcinogenesis, identificator of carcinogens, radiations and cancer – UV, ionising radiations – Xray, nuclear, microwave etc, DNA damge due to chemicals & radiations and DNA repair mechanisms, infections agents and cancer – RNA, DNA virus and carcinogenesis.

UNIT III PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9

Molecular cell biology of cancer, oncogenes – identification, classification and activation of proto oncogenes to oncogenes, tumour suppressor genes – caretaker and gate keeper genes, 2 hit hypothesis, loss of heterozygosity, APC, $CDKN_2A$, PTEN, Rb, Smad4, TGFβ, P53 and BRCA – Telomeres and Telomerases, Hall marks of cancer.

UNIT IV PRINCIPLES OF CANCER METASTASIS 6

Clinical significance of invasion, heterogeneity of metastatic phenotype, metastatic cascade, angiogenesis, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion – MMPs, cadherins integrins, Rho GTPase & HGf in cancer metastasis, metastatic suppressors.

UNIT V CANCER DETECTION AND THERAPY 9

Cancer screening and early detection, tumor markers, advances in cancer detection, Different forms of therapy, chemotherapy, radiation therapy, gene therapy, etc, prediction of aggressiveness of cancer. Use of signal targets towards therapy of cancer.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course student will be able

- To interpret signal transduction pathways and cell cycle in cancer
- To analyse the risk factors and stages of cancer
- To learn oncogenes and tumour suppressor genes
- To evaluate cancer metastasis and angiogenesis
- To analyse chemo, radiation and advanced therapy for cancer

TEXTBOOKS

1. Lewis J Kleinsmith, ‑Principles of Cancer Biology‖ Pearson new int. Edition, 2013.

REFERENCES

1. King, Roger J.B. ―Cancer Biology‖ Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. ‑Cancer Biology‖ IIIrd Edition . Oxford University Press, 1995.
3. Weinberg, R.A. ‑The Biology of Cancer‖ Garland Science, 2007
4. McDonald, F etal., ― Molecular Biology of Cancer‖ IInd Edition. Taylor & Francis, 2004.

BT17E66 BIOCONJUGATE TECHNOLOGY AND APPLICATIONS

L T P C
3 0 0 3

OBJECTIVES:

- To understand the functional targets and chemistry of active groups.
- To gain knowledge about the linkers and cleavable reagent systems.
- To know about enzyme, nucleic acid modification and its application in bioconjugation

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins – Modification of sugars, polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxylate reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homobifunctional cross linkers – Classification, structure, properties and uses of NHS esters, imido esters, sulfhydryl reactive cross linkers, difuluro benzene derivatives and homobifunctional esters. Heterobifunctional cross linkers – amine and sulfhydryl reactive cross linkers, carboxyl and sulfhydryl reactive CLs, sulfhydryl and photoreactive CLs, arginine and photoreactive CLs. Trifunctional cross linkers – Cleavable reagent systems.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labelling of DNA- enzyme conjugation to DNA.

UNIT V BIOCONJUGATE APPLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal – gold-labeled proteins – different methods of preparation and applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student would know about

- Modification and conjugation process of functional targets such as amino acids, proteins, sugars, polysaccharides, and nucleic acids
- Chemistry of reactive functionalities with reference to modification and cross linking process
- Types, structures, properties and applications of bioconjugate reagents
- Enzymes and nucleic acid modification and conjugation
- Preparation of various bioconjugates and their applications

TEXT BOOKS:

1. Bioconjugate Techniques, G.T. Hermanson, Academic Press, 1999.

REFERENCE BOOKS:

1. Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry,6thedition, CBS publishers and distributors, 2012.
2. LubertStryer W.H. Biochemistry, 5thRevised edition Freeman and company, New York, 2002.

BT17E67 FUNDAMENTALS OF NANOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To learn about basis of nanomaterial science, preparation method, types and application.

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completing this course, the students

- Will familiarize about the science of nanomaterials Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., ―Nanomaterials: Synthesis, Properties and Applications‖, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, ―Nanoscale characterization of surfaces & Interfaces‖, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), ―Nanotechnology‖, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),―The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations‖. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

BT17E68 PLANT BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the details about the genetic materials of plant cells.
- To understand the structure, function and genetic material of chloroplast and mitochondria.
- To study the concept of nitrogen fixation.
- To gain knowledge about the protocols followed for plant transformation using Agrobacterium and viral vectors.
- To give the student a basic knowledge in the plant tissue culture techniques, development of transgenic plants and molecular pharming.

UNIT I ORGANIZATION OF GENETIC MATERIAL 9

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation.

UNIT II CHLOROPLAST & MITOCHONDRIA 9

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins.

UNIT III NITROGEN FIXATION 9

Nitrogenase activity, nod genes, nif genes, bacteroids.

UNIT IV AGROBACTERIUM & VIRAL VECTORS 9

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits.

UNIT V APPLICATION OF PLANT BIOTECHNOLOGY 9

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming , theraputic products.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will be familiar with the details about the genetic materials of plant cells.
- Students willgain knowledge about the structure, function and genetic material of chloroplast and mitochondria.
- Students will gain knowledge about the importance of nitrogen fixation.
- Students can develop confidence about the protocols followed for plant transformation using Agrobacterium and viral vectors in plant breeding and their application to crop plants.
- Students will be able to get ideas on the basic knowledge in the plant tissue culture techniques, transgenic plants and molecular pharming.

TEXT BOOKS

1. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.
2. Singh BD. Text Book of Biotechnology, Kalyani Publishers. 1998
3. Adrian Slater, ―Plant Biotechnology‖, Oxford University Press, USA, 2003.

REFERENCES

1. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
2. Ignacimuthu .S, Applied Plant Biotechnology , Tata McGraw Hill. 1996.

BT17E69 BIOETHICS L T P C
3 0 0 3

OBJECTIVES:

- To give introduction about basic issues in engineering ethics, professional ideals and virtues with emphasis given to the moral problems engineers face in the corporate setting.
- To gain knowledge about Industrial standards, research ethics and codes of ethics
- To learn about the importance of safety and risk assessment in industries and risk benifit analysis in new product development
- To create awareness about IPR,Responsibilities and rights of employees and their responsibility about the environment and society.
- To stimulate critical and possible reflection of the moral issues and surrounding engineering practice and to provide the conceptual tools necessary for pursuing those issues

UNIT I ENGINEERING ETHICS 9

Senses of ‗Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas– Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of EthicalTheories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl and Bhopal Case Studies.

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students will gain knowledge about basics in ethics and moral values and understand about professional ideals and virtues.
- Students will gain knowledge about the importance of industrial standards and their responsibility to perform experiments as an engineer.
- Students will get awareness about safety and risk assessment in industries and the importance of risk benefit analysis
- Students will be informed of the intellectual property rights, professional responsibilities and rights of an engineer.
- At the end of the course, students will get information about various global issues and conceptional tools to overcome the engineering ethical issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, ―Ethics in Engineering‖, McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, ―Engineering Ethics – Concepts and Cases‖, Thompson Learning, (2000).

REFERENCES

1. Charles D Fleddermann, -Engineering Ethics‖, Prentice Hall, New Mexico, (1999).
2. John R Boatright, ―Ethics and the Conduct of Business‖, Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, ―Fundamentals of Ethics for Scientists and Engineers‖, Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, ―Business Ethics – An Indian Perspective‖, Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, ―Computers, Ethics and Society‖, Oxford University Press, (2003)

BT17E71 GENOMICS AND PROTEOMICS L T P C
3 0 0 3

OBJECTIVES:

To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT I INTRODUCTION 8

Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles.

UNIT II GENOME MAPPING AND SEQUENCING 10

Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies.

UNIT III FUNCTIONAL GENOMICS 9

Genome annotation, ORF and functional prediction,Gene finding,Substractive DNA library screening, Differential display and Representational difference analysis, SAGE,TOGA, Introduction to DNA microarray.

UNIT IV TECHNIQUES IN PROTEOMICS 9

In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels,Protein cleavage,Edman protein microsequencing, Massspectrometry- principles of MALDI-TOF, Peptide mass fingerprinting.

UNIT V PROTEIN PROFILING 9

Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students would have gained a better understanding of the organization of genomes in multiple levels of taxa, and the methodologies and approaches used for the study of structural and functional genomics. The students would have also acquired knowledge on various genome mapping and sequencing methods, genomic markers, microarray technology and methods for proteomics.

- Different methods used for genomics and proteomics .
- Apply functional genomics techniques in the laboratory
- The students will acquire in-depth knowledge on the methods and approaches in genomics and proteomics areas which help them to carry out cutting edge academic and industrial research.

TEXTBOOKS

1. Suhai, Sandor ―Genomics and Proteomics: Functional and Computational Aspects‖. Springer, 2000
2. Pennington, S.R. and M.J. Dunn ―Proteomics: From Protein Sequence to Function‖. VivaBooks Pvt. Ltd., 2002.
3. O'Connor, C.D. and B.D.Hames. ― Proteomics‖. Scion Publishing, 2008.
4. Primrose, S.B. and Twyman. ―Principles of Genome Analysis and Genomics‖. 7th Edition,Blakwell Publishing, 2006

REFERENCES

1. Cantor, Charles R. and Cassandra L. Smith. ―Genomics : The Science and Technology Behind the Human Genome Project‖. John Wiley & Sons, 1999.
2. Liebler, R.C. ―Introduction to Proteomics‖. Humana Press, 2002.
3. Hunt, Stephen P. and Frederick J. Livesey. ―Functional Genomics‖. Oxford University Press,2000.
4. Conard, Edward. ―Genomics‖. Apple Academics, 2010

BT17E72 BIOENTREPRENEURSHIP AND IPR L T P C
3 0 0 3

OBJECTIVES:

- To enable the students
- To be aware of the risks and benefits of being an entrepreneur
- To apply the knowledge and become a successful entrepreneur and assist other entrepreneurs

UNIT-I: **9**
Should You Become an Entrepreneur? What Skills Do Entrepreneurs Need? - Identify and Meet a Market Need - Entrepreneurs in a Market Economy - Select a Type of Ownership

UNIT-II: **9**
Develop a Business Plan

UNIT-III: **9**
Choose Your Location and Set Up for Business- Market Your Business - Hire and Manage a Staff

UNIT-IV: **9**
Finance, Protect and Insure Your Business - Record Keeping and Accounting - Financial Management

UNIT-V: **9**
Meet Your Legal, Ethical, Social Obligations - Growth in Today's Marketplace

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, students will be able:
- To acquire relevant knowledge on Entrepreneurs Need and Market Need
- To learn to develop a business plan
- To perform how to set up a business, advertise and hire and manage a staff
- To develop confidence in financial management
- To get ideas on Legal, Ethical, Social Obligation

TEXT BOOK
1. Entrepreneurship Ideas in Action – South Western, 2000.

REFERENCE BOOKS:
1.BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
2.. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
3. S.S.Kanka Entrepreneurship Development, S.Chand and Co, New Delhi 1997.

BT17E73 BASIC CONCEPTS IN TISSUE ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- To learn the fundamentals of tissue engineering ,tissue characteristics and the measurement of cellular components
- To study the type of tissues and growth factors involved in tissue repairing and the wound healing mechanism
- To explore naturally available biomaterials and synthetic nano materials for developing potential scaffolds to augment bone loss and other regenerative medicine
- To get familiarize with the characteristics and the role of stem cells in tissue architecture
- To acquire knowledge on clinical applications of tissue engineering and associated ethical issues

UNIT I INTRODUCTION **9**
Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Measurement of tissue characteristics ,appearance, cellular component, ECM component, mechanical measurements and physical properties.

UNIT II TISSUE ARCHITECTURE 9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, , Control of cell migration in tissue engineering.

UNIT III BIOMATERIALS 9

Biomaterials: Properties of biomaterials ,Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.

UNIT IV BASIC BIOLOGY OF STEM CELLS 9

Stem Cells : Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells,sources,embryonic stem cells, hematopoietic and mesenchymal stem cells,Stem Cell markers, FACS analysis, Differentiation,Stem cell systems- Liver, neuronal stem cells, Types & sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells.

UNIT V CLINICAL APPLICATIONS 9

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenrative diseases, spinal cord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy, orthopedicapplications, Stem cells and Gene therapy Physiological models, issue engineered therapies, product characterization, components, safety, efficacy. Preservation–freezing and drying. Patent protection and regulation of of tissue-engineered products, ethical issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will gain knowledge on the components of the tissue architecture
- Students will be able to interpret the type of tissues and growth factors involved in tissue repairing and the wound healing mechanism
- Students will be aware about the properties and broad applications of biomaterials
- Students can be familiarized with the stem cell characteristics and their relevance in medicine
- Students will be able to get ideas on overall exposure to the role of tissue engineering and stem cell therapy in organogenesis and associated patent and ethical issues.

TEXT BOOKS

1. Bernhard O.Palsson,Sangeeta N.Bhatia,‖Tissue Engineering‖ Pearson Publishers 2009.
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

REFERENCES

1. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancer applications, Nova Science Publishers, 2008.
2. Raphael Gorodetsky, Richard Schäfer..Stem cell-based tissue repair. RSC Publishing, 2011.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two-Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells, Academic Press, 2004.
4. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, Elsevier Academic press,2006.
5. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches In Tissue Engineering & Regenrative Medicine‖ Artech House, INC Publications, 2008.
6. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.and N. Fisk, Stem Cell Repair and Regeneration, volume-2, Imperial College Press,2007.

BT17E74 MARINE BIOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:
- To gain a strong knowledge about marine ecosystem and marine biotechnology
- To educate about the flora and fauna of marine environment
- To learn the ways and means to protect the environment from various types of pollution.
- To know the importance of marine products
- To learn the importance of aquaculture technology

UNIT I INTRODUCTION TO MARINE ENVIRONMENT 9
World oceans and seas – ocean currents – physical and chemical properties of sea water – abiotic and biotic factors of the sea – ecological divisions of the sea – history of marine biology, biogeochemical cycles – food chain and food web.

UNIT II IMPORTANT MARINE ORGANISMS 9
Phytoplanktons – zooplanktons – nektons – benthos – marine mammals – marine algae – mangroves – establishment nursery and restoration - coral reefs – deep sea animals and adaptation – intertidal zone – fauna and flora.

UNIT III MARINE ENVIRONMENTAL BIOTECHNOLOGY 9
Marine pollution – biology indicators (marine micro, algae) - biofilm – biodegradation and bioremediation – marine fouling and corrosion.

UNIT IV MARINE PHARMACOLOGY 9
Medicinal compound from marine flora and fauna – marine toxins , antiviral and antimicrobial agents.

UNIT V AQUACULTURE TECHNOLOGY 9
Importance of coastal aquaculture – marine fishery resources – common fishing, crafts and gears – aquafarm design and construction.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
- The students will be able to identify different marine ecosystems
- The students will be able to identify the flora and fauna of marine environment
- The students will be aware of the ways and means to protect the environment from various types of pollution.
- The students will be able to comprehend the importance of marine organisms and produce new marine products
- The students will be able to design aquaculture farm with new technology

TEXT BOOKS
1. Recent advances in marine biotechnology volume 3 – M.Fingerman, R . Nagabhushanam Mary – Frances Thomson.
2. Recent advances marine biotechnology volume 2 – M.Fingerman , R .Nagabhushanam Mary – Frances Thomson.

BT17E75 NEUROBIOLOGY AND COGNITIVE SCIENCES L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To know the general organization of brain and physiological and cognitive processes.
- To apply the molecular, cellular, and cognitive bases of learning and memory.

UNIT I NEUROANATOMY 9

What are central and peripheral nervous systems; Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.

UNIT II NEUROPHYSIOLOGY 9

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons.

UNIT III NEUROPHARMACOLOGY 9

Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function.

UNIT IV APPLIED NEUROBIOLOGY 9

Basic mechanisms of sensations like touch, pain, smell and taste; neurological mechanisms of vision and audition; skeletal muscle contraction.

UNIT V BEHAVIOUR SCIENCE 9

Basic mechanisms associated with motivation; control of feeding, sleep, hearing and memory; Disorders associated with the nervous system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, students will be able

- To know the anatomy and organization of nervous systems.
- To understand the function of nervous systems.
- To analyze how drugs affect cellular function in the nervous system.
- To understand the basic mechanisms associated with behavioral science.

TEXT BOOKS:

1. Mathews G.G. Neurobiology, 2nd edition, Blackwell Science, UK, 2000.
2. Gordon M. Shepherd G.M, and Shepherd Neurobiology, 3rd Edition Oxford University
3. Press, USA, 1994

REFERENCE BOOK:

1. Mason P., Medical Neurobiology, Oxford University Press, 2011.

BT17E76 STEM CELL TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic principles and fundamentals of stem cell technology
- To study the sources, growth factors and fate of the stem cells
- To learn the techniques to isolate and preserve the stem cells

UNIT I STEM CELLS AND CELLULAR PEDIGREES 9

Scope of stem cells- definition of stem cells- concepts of stem cells- differentiation, maturation, proliferation, pluripotency, self-maintenance and self renewal - problems in measuring stem cells - preservation protocols.

UNIT II STEM CELL CONCEPT IN PLANTS & ANIMALS 9

Stem cell and founder zones in plants- particularly their roots - stem cells of shoot meristems of higher plants. Adult stem cells in animals, skeletal muscle stem cell - Mammary stem cells- Intestinal Stem cells-

Keratinocyte stem cells of cornea-skin and hair follicles - Embryonic stem cell biology- factors influencing proliferation and differentiation of stem cells - hormone role in differentiation.

UNIT III CANCER STEM CELLS 9

Introduction, tumor stem cells, breast cancer stem cells, identification, & signalling in stem cells and cancer cells

UNIT IV HAEMOPOIETIC STEM CELL 9

Isolation of haemopoietic stem cells, its growth factors and the regulation of haemopoietic stem cells

UNIT V POTENTIAL USES OF STEM CELLS 9

Cellular therapies- vaccines-gene therapy - immunotherapy-tissue engineering - blood and bone marrow- Fc cells, Ethical issues in stemcells technology, stem cell regulations, debate, social and ethical concerns associated with it.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

- Gain knowledge the key principles of stem cell technology
- Acquire an idea of the current debate associated with the stem cell and its research
- Understand the source, preservation and the fate of stem cell in clinical research
- Gain knowledge and understanding the concepts and techniques of stem cell banking
- Applications of stem cell technology in different areas.

TEXT BOOKS

1. CS. Potten. Stem cells - Elsevier: 1997.
2. Robert Paul Lanza, Essentials of stem cell biology, 2006

REFERENCES

1. Clive Svendensen and Allison D. Ebert, Encyclopedia of stem cell research, volume 1
2. Berger A.C. BeachyS.H and Olson S .Stem Cells Therapies, National Academic Press, Washington DC, USA 2014.
3. Daniel R. Marshak, ―Stem cell biology‖ cold spring laboratory press.
4. Robert Lanza, -Essentials of stem cell biology‖ Elsevier, 2001

BT17E77 BIOSAFETY AND HAZARD MANAGEMENT L T P C

3 0 0 3

OBJECTIVES

Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification.

UNIT I 9

Need for safety in industries; Safety Programmes – components and realization; Potential hazards – extreme operating conditions, toxic chemicals; safe handling

UNIT II 9

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety

UNIT III **9**

Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapidand comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball.

UNIT IV **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis.

UNIT V **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Identify the safety needs of industries
- Apply the principles and implementation of safety procedures, risk analysis and assessment, hazard identification.

TEXT BOOKS

1. Fawatt, H.H. and Wood, W.S., ―Safety and Accident Prevention in Chemical Operation―, Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis : An introduction, Institution of chemical Engineers, U.K., 1997.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES

1. Handley, W., ―Industrial Safety Hand Book ―, 2nd Edn., McGraw-Hill Book Company,1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., ―Industrial Accident Prevention―, McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prentice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994

BT17E78 ADVANCED IMMUNOTECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge about the development of immune cells and their function
- To provide knowledge on immune defence mechanism, through which pathogen elimination occurs
- To explain the principle of various immunological techniques
- To provide basic knowledge on various types of vaccines and their development
- To enable the student to lay a strong foundation on immunological oriented research.

UNIT I INTRODUCTION **12**

Cells of the immune system and their development; primary and secondary lymphoid organs; humoral and cell mediated immune responses; complement activation pathway.

UNIT II ANTIBODIESAND IMMUNO TECHNIQUES **10**

Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay;

Plaque Forming Cell Assay, western blotting, RIA and immunofluoresence.

UNIT III CELLULAR IMMUNOLOGY 8

PBMC seperation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing.

UNIT IV VACCINE TECHNOLOGY 6

Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology

UNIT V IMMUNOTHERAPEUTICS 9

Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation, fusion proteins, cellular therapies and immunosuppressive therapy.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will

- Identify the role of the immune system on elimination of pathogens
- Basic principles of various immunological techniques
- Ability to separate the immune cells based onCD markers and also acquired the ability to perform cytokine bioassay.
- Vaccine principle and their advancement, Articulate applications of immunology in the modern world.

TEXT BOOKS

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997.
2. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001.
3. Goldsby , R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H. Freeman, 2003.

REFERENCE BOOK:

1.Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997.

BT17E79	COMPREHENSIVE COURSE FOR BIOTECHNOLOGISTS	Category	L	T	P	C
		PE	3	0	0	3

Course objectives:

This course will enable the students to

- Reminisce and apply the basic concepts in the different facets of biotechnology.
- Understand the chemical basis of life, cellular and immune processes and mechanisms.
- Apply analytical and bioinformatics approach to drug design and delivery.
- Understand and apply the basic principles in stoichiometry, thermodynamics and transport processes.
- Gain knowledge in the field of bioprocess, upstream and downstream processing.

UNIT-I FUNDAMENTALS OF LIFE SCIENCES 9

Basic principles of Bio organic chemistry (covalent and non-covalent interactions with respect to structure and functions of biomolecules – peptide , phosphor diester and glycosidic bonds, hydrogen bonds, ionic interactions , hydrophobic interactions and vander waals forces) Isomers, stereo isomers, epimers, anomers, mutarotation, pH, buffers. Enzymes and significance of metabolic pathways. ATP as energy currency. Eukaryotes and prokaryotes – structure and functions. Gram negative and gram positive, pathogenic and beneficial bacteria. Production of secondary metabolites like antibiotics and enzymes. Cell signalling and biological transport.

UNIT- II BASIC CONCEPTS IN MOLECULAR BIOLOGY AND IMMUNOLOGY 9

Structure of nucleic acids, DNA replication, repair, transcription, translation and regulation of gene expression. Structure function relationship of proteins, rDNA technology (cloning vectors, Crispr Cas 9).Transgenic techniques in animals and plants. Types of immune response, innate and acquired immunity (antigen, antibodies, APC, MHC, T, B and cytotoxic T Lymphocytes, ELISA, hypersensitivity and autoimmunity.

UNIT-III ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY, BIOINFORMATICS AND DRUG DISCOVERY **9**

Instrumentation and analytical techniques in biotechnology – Principles and applications of colorimetry, spectrophotometry, flow cytometry, chromatography, electrophoresis, NMR, X-Ray diffraction etc., Linux commands - Biological Databases - Dynamic Programming Algorithms - BLAST - Phylogeny trees - Homology modelling - ANN in PSSP. Bioinformatics in drug designing .Pharmacokinetics, pharmacodynamics, clinical trials and drug discovery.

UNIT-IV ENGINEERING PRINCIPLES APPLIED TO BIOLOGICAL SYSTEMS, THERMODYNAMICS AND TRANSPORT PROCESSES **9**

Material and energy balances. Recycle, bypass and purge processes; Stoichiometry of growth and product formation. Laws of thermodynamics; Solution thermodynamics; Phase equilibria. Newtonian and non-Newtonian fluids, fluid flow - laminar and turbulent; Mixing in bioreactors, Molecular diffusion and film theory; kLa and its measurement; Conductive and convective heat transfer, overall heat transfer coefficient; Heat exchangers.

UNIT-V BIOPROCESS ENGINEERING AND PROCESS BIOTECHNOLOGY **9**

Rate law, zero and first order kinetics; Ideal reactors - batch, mixed flow and plug flow; Enzyme immobilization kinetics, Optimization and scale up. Kinetics of cell growth, substrate utilization and product formation; Batch, fed-batch and continuous processes. Media formulation and optimization; Sterilization of air and media; Filtration - membrane filtration, ultrafiltration; Centrifugation, Cell disruption; Principles of chromatography.

Total Contact Hours : 45

Course outcomes:

Upon completion of the course, the students will be able to

Prepare for competitive exams.

- Gain knowledge about theoretical and practical aspects of biotechnology.
- Apply bioinformatics tools in molecular modelling and drug designing.
- Solve problems in the Material and energy balances, thermodynamics, heat and mass transfer.
- Solve problems in reactor design and downstream processing.

Text/Reference books:

- Pamela C Champe, Richard A. Harvey, Lippincott's illustrated reviews, Biochemistry, Third Edition, Lippincott Williams & Wilkins 2005.
- Cooper, G.M. and R.E. Hansman ‐The Cell : A Molecular Approach‖, IVth Edition, ASM Press, 2007.
- Wilson & Walker, Principles and Techniques of Biochemistry and Molecular Biology, 7th edition, 2018.
- Friefelder, David. ‐Molecular Biology.‖ Narosa Publications, 1999.
- Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.
- Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.
- Presscott, S.C. and Cecil G. Dunn, ―Industrial Microbiology‖, Agrobios (India), 2005.
- Bhatt, B.I. and S.M. Vora ‐Stoichiometry (SI Units), 3rd Edition, Tata McGrawHill, 1996.
- Smith J.M., Van Ness H.C., and Abbot M.M. ‐Introduction to Chemical Engineering Thermodynamics‖, VIth Edition. Tata McGraw-Hill, 2003.
- Geankoplis C.J. Transport Processes And Unit Operations. Prentice Hall India.2002.
- McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. Mcgrawhill. 1993.

- Shuler, Michael L. and Fikret Kargi, ―Bioprocess Engineering―, Prentice Hall, 1992.
- Doran, Pauline ‐of Bioprocess Engineering Principles ‐. Elsevier, 1995.
- Treybal R.E. Mass Transfer Operations.3rd edition. McGraw-Hill, 1981.
- Levenspiel O. Chemical Reaction Engineering. 3rd Edition. John Wiley.1999.
- Belter, P.A., E.L. Cussler and Wei-Houhu ―Bioseparations – Downstream Processing for Biotechnology‖, John Wiley, 1988.