RAJALAKSHMI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

DEPARTMENT OF BIOTECHNOLOGY

CURRICULUM AND SYLLABUS REGULATIONS – 2019

B.TECH –BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION

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

MISSION

- 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 ability 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	L	T	P	Total Hours	Total Credits	Category
THEORY& PRACTICALS								
1	HS19151	Technical English	2	1	0	3	3	HS
2	MA19153	Applied Calculus	3	1	0	4	4	BS
3	PH19142	Physics for Bioscience	3	0	2	5	4	BS
4	GE19101	Engineering Graphics	2	2	0	4	4	ES
5	GE19121	Engineering Practices- (Civil and Mechanical)	0	0	2	2	1	ES
6	MC19101	Environmental Science and Engineering (Non Credit course)	3	0	0	3	0	MC
		TOTAL	**13**	**4**	**4**	**21**	**16**	

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SEMESTER – II

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY& PRACTICALS								
1	MA19251	Differential Equations and Vector Calculus	3	1	0	4	4	BS
2	CY19141	Chemistry for Technologists	3	0	2	5	4	BS
3	GE19211	Problem Solving and Programming in Python	1	0	4	5	3	ES
	GE19202	Basic Civil and Mechanical Engineering	3	0	0	3	3	ES
4	BT19201	Biochemistry	3	0	0	3	3	PC
5	MC19102	Indian Constitution and Freedom Movement (Non credit course)	3	0	0	3	0	MC
6	BT19211	Biochemistry Laboratory	0	0	4	4	2	PC
		TOTAL	**17**	**1**	**10**	**27**	**19**	

SEMESTER –III

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	MA19353	Transforms and Numerical Methods	3	1	0	4	4	BS
2	BT19301	Microbiology	3	0	0	3	3	PC
3	BT19302	Enzyme Technology and Biotransformations	3	0	0	3	3	PC
4	BT19303	Cell Biology	3	0	0	3	3	PC
5	BT19304	Stoichiometry and Thermodynamics	3	2	0	5	4	ES
6	BT19305	Basic Industrial Biotechnology	3	0	0	3	3	PC
PRACTICALS								
7	BT19311	Microbiology Laboratory	0	0	3	3	1.5	PC
8	BT19312	Basic Biotechnology Laboratory	0	0	3	3	1.5	PC
		TOTAL	**18**	**3**	**6**	**27**	**23**	

SEMESTER –IV

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	MA19453	Probability and Statistics	3	1	0	4	4	BS
2	BT19401	Analytical Techniques in Biotechnology	3	0	0	3	3	ES
3	BT19402	Fluid Mechanics and Heat transfer	3	1	0	4	3	ES
4	BT19403	Food Biotechnology	3	0	0	3	3	ES
5	CS19411	Python Programming for Machine Learning	1	0	4	5	3	ES
6	MC19301	Essence of Indian Traditional Knowledge (Non Credit course)	3	0	0	3	0	MC
PRACTICALS								
7	BT19411	Heat and Mass Transfer Laboratory	0	0	3	3	1.5	ES
8	BT19412	Food Processing and Preservation Laboratory	0	0	3	3	1.5	ES
9	GE19421	Soft skills - I	0	0	2	2	1	EEC
		TOTAL	**16**	**2**	**12**	**30**	**20**	

SEMESTER – V

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT19501	Bioprocess Principles	3	0	0	3	3	PC
2	BT19502	Molecular Biology	3	0	0	3	3	PC
3	BT19503	Separation Process Principles	3	1	0	4	3	ES
4	BT19504	Immunology	3	0	0	3	3	PC
5		Professional Elective I	3	0	0	3	3	PE
6		Open Elective I*	3	0	0	3	3	OE
PRACTICALS								
7	BT19511	Bioprocess Laboratory- I	0	0	3	3	1.5	PC
8	BT19512	Immunology Laboratory	0	0	3	3	1.5	PC
9	GE19521	Soft Skills-II	0	0	2	2	1	EEC
		TOTAL	**18**	**1**	**8**	**27**	**22**	

SEMESTER – VI

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT19601	Bioprocess Technology	3	0	0	3	3	PC
2	BT19602	Genetic Engineering	3	0	0	3	3	PC
3	BT19603	Chemical Reaction Engineering	3	0	0	3	3	ES
4	BT19604	Innovation and Design Thinking for Biotechnologists	0	0	4	4	2	EEC
5		Professional Elective II	3	0	0	3	3	PE
6		Open Elective II *	3	0	0	3	3	OE
PRACTICALS								
7	BT19611	Bioprocess Laboratory II	0	0	4	4	2	PC
8	BT19612	Molecular Biology and Genetic Engineering Laboratory	0	0	4	4	2	PC
9	BT19613	Numerical Programming for Biotechnologists	0	0	2	2	1	PC
10	BT19614	Industry Training (2 weeks training during vacation)	0	0	0	0	1	EEC
11	GE19621	Problem Solving Techniques	0	0	2	2	1	EEC
		TOTAL	**15**	**0**	**16**	**31**	**24**	

SEMESTER – VII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
THEORY								
1	BT19701	Downstream Processing	3	1	0	4	3	PC
2	BT19702	Bioinformatics	3	0	0	3	3	PC
3	BT19703	Protein Engineering	3	0	0	3	3	PC
4		Professional Elective III	3	0	0	3	3	PE
5		Professional Elective IV	3	0	0	3	3	PE
6		Professional Elective V	3	0	0	3	3	PE
PRACTICALS								
7	BT19711	Downstream Processing Laboratory	0	0	3	3	1.5	PC
8	BT19712	Bioinformatics Laboratory	0	0	3	3	1.5	PC
9	BT19713	Artificial Intelligence and Machine Learning for Biotechnologist	0	0	4	4	2	PC
10	CR19P61	Microfluidics Laboratory	0	0	2	2	1	PE
		TOTAL	**18**	**1**	**12**	**31**	**24**	

SEMESTER – VIII

Sl. No	COURSE CODE	COURSE TITLE	L	T	P	Total Hours	Total Credits	Category
PRACTICALS								
1	BT19801	Project Work	0	0	30	30	15	EEC
		TOTAL			**30**	**30**	**15**	

TOTAL CREDITS: 163

SUMMARY

S.NO.	SUBJECT AREA	CREDITS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	3								**3**
2.	BS	8	8	4	4					**24**
3.	ES	5	6	4	15	3	3			**36**
4.	PC		5	15		12	11	14		**57**
5.	PE					3	3	10		**16**
6.	OE					3	3			**6**
7.	EEC				1	1	4		15	**21**
8	MC	*	*	*						
Total		**16**	**19**	**23**	**20**	**22**	**24**	**24**	**15**	**163**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE – I (SEMESTER-V)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT19P51	Biopharmaceutical Technology	PE	3	3	0	0	3
2	BT19P52	Clinical Biochemistry	PE	3	3	0	0	3
3	BT19P53	Fundamentals of Nanotechnology	PE	3	3	0	0	3
4	BT19P54	Biosafety and Hazard Management	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	BT19P61	Marine Biotechnology	PE	3	3	0	0	3
2	BT19P62	Medical Microbiology	PE	3	3	0	0	3
3	GE19304	Fundamentals of Management for Engineers	PE	3	3	0	0	3
4	BT19P64	Plant Biotechnology	PE	3	3	0	0	3
5	BT19P65	Bioentrepreneurship and IPR	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (SEMESTER-VII)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT19P71	Comprehensive Course for Biotechnologists	PE	3	3	0	0	3
2	BT19P72	Molecular Pathogenesis of Infectious Diseases	PE	3	3	0	0	3
3	BT19P73	Clinical Proteomics	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	BT19P74	Cancer Biology	PE	3	3	0	0	3
2	BT19P75	Biophysics	PE	3	3	0	0	3
3	BT19P76	Animal 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	BT19P77	Stem cell and Regenerative medicine	PE	3	3	0	0	3
2	BT19P78	Neurobiology and Cognitive Sciences	PE	3	3	0	0	3
3	BT19P79	Bioconjugate Technology and Applications	PE	3	3	0	0	3

OPEN ELECTIVES OFFERED BY DEPARTMENTOF BIOTECHNOLOGY

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OBT1901	Food and Healthy Living	OE	3	3	0	0	3
2	OBT1902	Man and Microbes	OE	3	3	0	0	3
3	OBT1903	Basic Bioinformatics	OE	3	3	0	0	3
4	OBT1904	Biotechnology in Product Development	OE	3	3	0	0	3
5	OBT1905	Medical Sciences for Engineers	OE	3	3	0	0	3
6	OBT1906	Application of Biotechnology for Environmental protection	OE	3	3	0	0	3
7	OBT1907	Fermentation Technology	OE	3	3	0	0	3
8	OBT1908	Essentials Of Life Science For Engineers	OE	3	3	0	0	3

HS19151 TECHNICAL ENGLISH Category L T P C

Common to all branches of B.E./ B.Tech programmes – I semester HS 2 1 0 3

Course objectives:

This course will enable the students

- To enable learners to acquire basic proficiency in English reading and listening.
- To write in English precisely and effectively.
- To speak flawlessly in all kinds of communicative contexts.

UNIT I VOCABULARY BUILDING 12

The concept of word formation - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives - Synonyms, antonyms, and standard abbreviations. Compound words – abbreviation – single word substitution – **Listening:** Listening comprehension, listening to motivational speeches, podcasts and poetry. **Speaking:** Short talks on incidents - place of visit – admiring personalities, etc.

UNIT-II BASIC WRITING SKILLS 12

Sentence structures - Use of phrases and clauses in sentences - punctuation - coherence - Organizing principles of paragraphs in documents - Techniques for writing precisely. **Reading & Writing** – Free writing – paragraphs - article reading and writing criticism - change of tense forms in short text or story – inferential reading – rewrite or interpret text - prepare questions based on the text. **Speaking:** Everyday situations – conversations and dialogues, speaking for and against.

UNIT-III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Subject-verb agreement- Noun-pronoun agreement - Articles – Prepositions – Redundancies. **Reading & Writing:** Read from innovation and ideas that changed the world, newspaper column writing – **Speaking:** Demonstrative speaking practice using visual aids (charts, graphs, maps, pictures, etc,.).

UNIT-IV WRITING FOR FORMAL PRESENTATION 12

Nature and Style of sensible Writing - Describing – Defining – Classifying - Providing examples or evidence - Writing introduction and conclusion. **Reading & Writing –** Read from Literary pieces – identify different parts text – difference between print and digital writing. Writing: Recommendations - Foreword - Review of book. **Speaking-** Formal Presentations – Debate on social issues/taboos and solutions.

UNIT-V EXTENDEDWRITING AND SPEAKING 12

Writing: Précis writing – Essay writing – workplace communication: Resume – Business letters and emails – Proposals. **Speaking:** Panel discussion – reporting an event – mock interview – Master Ceremony.

Total Contact Hours : 60

Course outcomes:

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

- Discuss and respond to the listening content.
- Read and comprehend different texts and appreciate them
- Understand structures and techniques of precise writing
- Analyse different genres of communication and get familiarized with new words, phrases, and sentence structures.
- Write and speak appropriately in varied formal and informal contexts.

Text books:

- English for Technologists & Engineers, Orient BlackSwan Publications, Chennai.

Reference books:

- Technical Communication, Meenakshi Raman & Sangeeta Sharma, Oxford University Press.
- Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi.
- Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press.
- Practical English Usage. Michael Swan. OUP. 1995.
- Remedial English Grammar. F.T. Wood. Macmillan.2007
- On Writing Well. William Zinsser. Harper Resource Book. 2001
- Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS19151. 1	1	-	-	-	-	-	1	-	2	3	1	3	1	1	1
HS19151. 2	-	3	-	2	-	-	-	-	-	2	1	1	1	1	1
HS19151. 3	-	-	-	1	-	-	-	-	-	3	-	-	1	1	1
HS19151. 4	-	1	-	1	-	-	-	-	-	3	-	2	1	1	1
HS19151. 5	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
Average	0.4	1	0.2	1	0.2	0.2	0.4	0.2	0.8	2.8	0.6	1.2	1	1	1

MA19153 APPLIED CALCULUS Category L T P C

Common to I sem. B.Tech. – BIOTECH, FOOD TECH & CHEM BS 3 1 0 4

Course objectives:

This course will enable the students to

- To gain knowledge in using matrix algebra techniques.
- To understand the techniques of calculus which are applied in the Engineering problems.

UNIT I MATRICES 12

Symmetric and skew – symmetric matrices , orthogonal matrices – Eigen values and Eigen vectors - Cayley – Hamilton theorem (without proof) and applications - orthogonal transformation and quadratic forms to canonical forms - Nature of quadratic forms.

UNIT-II APPLICATION OF DIFFERENTIAL CALCULUS 12

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolutes as envelope of normals.

UNIT-III FUNCTIONS OF SEVERAL VARIABLES 12

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 APPLICATION OF INTEGRATION AND IMPROPER INTEGRALS 12

Evaluation of area, surface area and volume of revolution - Centre of Gravity – Moment of inertia – Improper integrals: Beta and Gamma integrals and their properties.

UNIT-V MULTIPLE INTEGRAL 12

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 Contact Hours : 60

Course outcomes:

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

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix for solving problems
- Analyze, sketch and study the properties of different curves.
- Handle functions of several variables and problems of maxima and minima.
- Apply the techniques of integration in engineering problems and to use the concept of improper integrals.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

Text books:

- Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
- T Veerarajan, Engineering Mathematics –I, Mc Graw Hill Education, 2014

Reference books:

- Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
- Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
- Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.

PO/PSO / CO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA 19153.1	3	3	3	3	3	1	-	-	-	-	2	2	3	-	1
MA 19153.2	3	3	3	3	3	1	1	-	-	-	1	3	3	1	2
MA 19153.3	3	3	3	3	3	1	1	-	-	-	2	3	3	-	2
MA 19153.4	3	3	3	3	2	1	1	-	-	-	1	2	3	-	2
MA 19153.5	3	3	3	3	2	1	-	-	-	-	1	2	3	-	2
Average	3	3	3	3	2.6	1	1	-	-	-	1.4	2.4	3	1	1.8

PH19142	PHYSICS FOR BIOSCIENCE	Category	L	T	P	C
	Common to I sem. B.E. – BME and B.Tech -Bio.Tech & Food Tech	BS	3	0	2	4

Course objectives:

This course will enable the students

- To enhance the fundamental knowledge of Physical, Quantum, magnetic and dielectric properties of materials
- To study the behavior of light, sound and nuclear radiation in materials.

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 QUANTUM PHYSICS AND SUPERCONDUCTIVITY 9

Introduction to wave function - derivation of Schrodinger wave equation -Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids - Tunneling -scanning tunneling microscope. - Introduction of Superconductivity - Properties of Superconductors - Meissner Effect - BCS theory (qualitative) - Type-I and Type II Superconductors -Magnetic Levitation and SQUID.

UNIT-III MAGNETIC AND DIELECTRIC MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility– types of magnetic materials – microscopic classification of magnetic materials – Ferromagnetism origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behavior – Hard and soft magnetic materials - Introduction electrostatics and EM waves – Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model.

UNIT-IV WAVES, OPTICS, AND SOUND 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation -Physics of light-Measurement of light and its unit – an overview of limits of vision and colour vision - Physics of sound, Normal sound levels –ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) Non-destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications – Sonogram.

UNIT-V NUCLEAR AND PARTICLE PHYSICS 12

Radioactivity - characteristics of radioactive material – isotopes - probing by isotopes, reactions involved in the preparation of radioisotopes, the Szilard-Chalmer's reaction – radiochemical principles in the use of tracers - nuclear medicines – Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation. Gamma-Ray Spectrometry- Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters.

Total Contact Hours : 45

Text books:

- Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
- Umesh K Mishra &Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
- Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.
- B.H Brown, R.H.Smallwood, D.C Barber . P.V Lawford Medical physics and Biomedical Engineering, CRC Press 1998.

Reference books:

- S. O. Pillai, Solid state physics, New Age International, 2015
- Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), 7th edition, McGraw-Hill Education, 1994.
- J.B.Rajam, Atomic Physics, 7th edition, S.Chand, 2010
- B.L.Theraja, Modern Physics, 16th edition, S.Chand, 2012.
- Charles Kittel, Introduction to Solid State Physics, 8th Edition, Willey India Pvt.Ltd, 2005.
- Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.

- Arnikar, H. J., Essentials of Nuclear Chemistry, 4th Edn., New Age International Publishers Ltd., New Delhi, 1995

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 10 experiments) 30

1 Determination of Young's Modulus of the given material by Uniform bending.
2 Determination of Young's Modulus of the given material by Non Uniform bending.
3 Determination of Rigidity Modulus of the given material by Torsion pendulum.
4 Determination of Band gap of given Semiconducting material.
5 To determine the work function and threshold frequency using Einstein's Photoelectric effect.
6 Experiments on electromagnetic induction – B-HCurve experiment to determine magnetic parameter.
7 Determination of free space permeability using Helmholtz coil.
8 Diffraction- Determination of wavelength of diode laser.
9 Measurement of speed of light using fiber cable.
10 Spectrometer - Minimum deviation of a prism.
11 Determination of Resonance frequency of LC circuit and LCR circuits
12 Detection of ionizing radiation using Geiger Muller Counter

PERIODS:30
TOTAL PERIODS:75

Use the basic instruments like vernier caliper, micrometer and microscope for various basic measurements.

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

- Apply the knowledge of properties of matter, elasticity and bending moments of beam for real time applications
- Understand and apply the principles of quantum physics and superconductivity in devices.
- Make use of magnetic and dielectric properties of materials in engineering and technology.
- Apply the properties of optics and sound to develop innovating instruments.
- Utilize the concepts of nuclear and particle physics in imaging and irradiation techniques.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH19142 .1	3	2	2	2	2	1	1	1	1	1	1	2	2	2	2
PH19142 .2	3	2	2	2	2	1	1	1	1	1	1	2	2	2	2
PH19142. 3	3	3	3	3	2	1	1	1	1	1	1	2	2	2	2
PH19142 .4	3	2	2	2	2	1	1	1	1	1	1	2	2	2	2
PH19142 .5	3	2	2	2	2	1	1	1	1	1	1	2	2	2	2
Average	3	2.2	2.2	2.2	2	1	1	1	1	1	1	2	2	2	2

GE19101 ENGINEERING GRAPHICS Category L T P C
Common to all branches ES 2 2 0 4

Course objectives:
This course will enable the students to

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- T o expose the students to the existing national standards related to technical drawings.

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. Basic Geometrical constructions.

UNIT-I PLANECURVES AND FREE HAND SKETCH 11

Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method– Construction of cycloids, Construction of involutes of square and circle–Drawing of tangents and normal to the above curves.

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 OFPOINTS, LINES AND PLANE SURFACE 15

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

UNIT-III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder and cone 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 15

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.

UNIT-V ISOMETRIC, PERSPECTIVE PROJECTIONS AND FREE HAND SKETCHING 15

Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids Prisms, pyramids and cylinders by visual ray method.

Total Contact Hours : 60

Course outcomes:

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

- do the construction of plane curves and orthographic projection of points
- do the orthographic projection of lines and plane surfaces.
- do the projections of solids
- do the section of solids and development of lateral surfaces
- prepare isometric, perspective projection of simple solids and free hand sketching

Text books:

- Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
- Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers,Chennai, 2017.

Reference books:

- Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International(P)Limited, 2008.
- Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
- Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
- 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.
- Shah M.B., and Rana B.C.,"Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

- IS10711– 2001:Technical products Documentation– Size and layout of drawing sheets.
- IS9609(Parts0&1)–2001:TechnicalproductsDocumentation–Lettering.
- IS10714(Part20)–2001&SP46–2003: Lines for technical drawings.

- IS11669– 1986&SP46–2003: Dimensioning of Technical Drawings.
- IS15021(Parts1 to4)–2001:Technicaldrawings–Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
GE19101.1	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.2	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.3	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.4	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.5	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
Average	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-

		Category	L	T	P	C
GE19121	**ENGINEERING PRACTICES – Civil and Mechanical**	**ES**	**0**	**0**	**2**	**1**

Objectives:

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

List of Exercises

CIVIL ENGINEERING PRACTICE

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2. Preparation of basic plumbing line sketches for wash basins, water heaters, etc.
3. Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.

Carpentry Works:

4. Study of joints in roofs, doors, windows and furniture.
5. Hands-on-exercise: Woodwork, joints by sawing, planning and chiseling.

MECHANICAL ENGINEERING PRACTICE

6. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
7. Gas welding practice.

Basic Machining:

8. Simple Turning and Taper turning
9. Drilling Practice

Sheet Metal Work:

10. Forming & Bending:
11. Model making – Trays and funnels
12. Different type of joints.

Machine Assembly Practice:

13. Study of centrifugal pump

14 Study of air conditioner

Total Contact Hours : 30

Course Outcomes:

- Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
- Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
- Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
- Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
- Able to perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

TOTAL: 30 PERIODS

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	**PSO1**	**PSO2**	**PSO3**
GE19121.1	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1
GE19121.2	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1
GE19121.3	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1
GE19121.4	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1
GE19121.5	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1
Average	2	1	1	-	2	1	2	-	1	-	1	3	-	-	1

MC19101 ENVIRONMENTAL SCIENCE AND ENGINEERING (NON CREDIT COURSE) **Category L T P C**

Common to I sem. B.E. – AERO, AUTO, BME, CIVIL, MECH & MCT and B.Tech. – BIOTECH, CHEMICAL & FOOD TECH. And common to II sem. B.E. – CSE, ECE & EEE and B.Tech. – IT **MC 3 0 0 0**

Course objectives:

This course will enable the students

- To understand the importance of natural resources, pollution control and waste management.
- To provide the students about the current social issues and environmental legislations.

UNIT I NATURAL RESOURCES 9

Environment -definition - scope and importance - forest resources -use and overexploitation -water resources -use and over utilization - dams - benefits and problems - water conservation -energy resources - growing energy needs - renewable and non- renewable energy sources - use of alternate energy sources -land resources -land degradation - role of an individual in conservation of natural resources.

UNIT-II ENVIRONMENTAL POLLUTION 9

Definition - causes, effects and control measures of air pollution -chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, and ozone depletion- noise pollution -mitigation procedures - control of particulate and gaseous emission(Control of SO_2, NO_X, CO and HC).

Water pollution - definition-causes-effects of water pollutants–marine pollution-thermal pollution-radioactive pollution-control of water pollution by physical, chemical and biological processes–waste water treatment-primary, secondary and tertiary treatment.

Soil pollution : definition-causes-effects and control of soil pollution.

UNIT-III SOLID WASTE MANAGEMENT 9

Solid wastes - sources and classification of solid wastes -solid waste management options - sanitary landfill, recycling, composting, incineration, energy recovery options from wastes

Hazardous waste -definition -sources of hazardous waste-classification (biomedical waste, radioactive waste, chemical waste, household hazardous waste)-characteristics of hazardous waste ignitability (flammable) reactivity, corrosivity, toxicity -effects of hazardous waste -case study- bhopal gas tragedy - disposal of hazardous waste-recycling , neutralization, incineration, pyrolysis, secured landfill - E-waste management -definition-sources-effects -electronic

waste recycling technology.

UNIT-IV SOCIAL ISSUES AND THE ENVIRONMENT 9

Sustainable development -concept, components and strategies - social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine - consumerism and waste products - environment and human health - role of information technology in environment and human health -disaster management– floods, earthquake, cyclone and landslide.

UNIT-V TOOLS FOR ENVIRONMENTAL MANAGEMENT 9

Environmental impact assessment (EIA) structure -strategies for risk assessment–EIS-environmental audit-ISO 14000-precautionary principle and polluter pays principle- constitutional provisions- - pollution control boards and pollution control acts- environmental protection act1986- role of non-government organisations- international conventions and protocols.

Total Contact Hours : 45

Course outcomes:

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

- Be conversant to utilize resources in a sustainable manner.
- Find ways to protect the environment and play proactive roles.
- Apply the strategies to handle different wastes
- Develop and improve the standard of better living.
- Be conversant with tools of EIA and environmental legislation.

Text books:

- Benny Joseph, "Environmental Science and Engineering", 2nd edition, Tata McGraw-Hill, New Delhi,2008.
- Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd

Reference books:

- Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt Ltd, New Delhi, 2007.
- Erach Bharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press(I) Pvt Ltd, Hydrabad, 2015.
- G. Tyler Miller and Scott E. Spoolman, "Environmental Science", 15th edition, Cengage Learning India PVT, LTD, Delhi, 2014.
- Rajagopalan, R, "Environmental Studies-From Crisis to Cure", 3rdedition, Oxford University Press,2015.
- Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC19101. 1	2	2	2	1	1	3	3	3	1	1	1	2	1	2	2
MC19101. 2	3	2	2	2	2	3	3	3	2	2	2	2	2	2	2
MC19101. 3	3	1	2	1	1	2	2	2	1	2	1	2	1	1	2
MC19101. 4	2	2	2	2	2	2	3	2	1	2	2	2	1	2	2
MC19101. 5	2	2	2	1	2	2	2	2	1	1	1	1	1	1	2
Average	2.4	1.8	2	1.4	1.6	2.4	2.6	2.4	1.2	1.6	1.4	1.8	1.2	1.6	2

MA19251 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS Category L T P C

Common to II sem.B.E. - AERO,AUTO,CIVIL,MCT & MECH and B. Tech. - BIOTECH, FOOD TECH. & CHEM **BS 3 1 0 4**

Course objectives:

This course will enable the students

- To handle practical problems arise in the field of engineering and technology using differential equations.
- To solve problems using the concept of Vectors calculus, Complex analysis, Laplace transforms.

UNIT I SECOND AND HIGHER ORDER DIFFERENTIAL EQUATIONS 12

Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters – Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients.

UNIT-II PARTIAL DIFFERENTIAL EQUATIONS 12

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

UNIT-III VECTOR CALCULUS 12

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

UNIT-IV ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping and Bilinear transformation- Cauchy's integral theorem and Cauchy's integral formula (proof excluded) – Taylor's series and Laurent's series – Singularities – Residues – Residue theorem (without proof), simple problems.

UNIT-V LAPLACE TRANSFORM 12

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

Total Contact Hours : 60

Course outcomes:

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

- Apply various techniques in solving ordinary differential equations.
- Develop skills to solve different types of partial differential equations
- Use the concept of Gradient, divergence and curl to evaluate line, surface and volume integrals.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving Engineering problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

Text books:

- Grewal B.S., "Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
- T Veerarajan, Engineering Mathematics –II , Mc Graw Hill Education, 2018.

Reference books:

- Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
- Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
- Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.
- T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA19251.1	3	3	3	3	3	2	-	-	-	-	2	2	3	1	3
MA19251.2	3	3	3	3	3	2	-	-	-	-	2	2	3	1	3
MA19251.3	3	3	3	3	2	1	-	-	-	-	2	2	3	1	2
MA19251.4	3	3	2	2	2	1	-	-	-	-	1	1	2	1	1
MA19251.5	3	3	2	2	2	1	-	-	-	-	1	1	2	1	1
Average	3	3	2.6	2.6	2.4	1.4	-	-	-	-	1.6	1.6	2	1	2

CY19141 CHEMISTRY FOR TECHNOLOGISTS Category L T P C
Common to I sem. B.Tech. - CHEMICAL and BS 3 0 2 4
II sem. B.Tech. - BIO. TECH. and FOOD TECHNOLOGY

Course objectives:
This course will enable the students

- To acquire molecular level understanding of matter
- To understand the basics of surface chemistry and nanomaterials
- To attain knowledge on natural products and polymers

UNIT I CHEMICAL BONDING 9

Types of chemical bonds - electronegativity - bond polarity and dipole moments, partial ionic character of covalent bonds - VB theory - concept of hybridization. Molecular orbital theory - LCAO - bonding in homonuclear and heteronuclear diatomic molecules. Intermolecular forces - types - hydrogen bonding - importance of hydrogen bonding in biomolecules - van der Waals forces – consequences.

UNIT-II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption-difference between adsorption and absorption-types-factors influencing adsorption- adsorption from solutions- types of isotherms-Freundlich adsorption isotherm -Langmuir adsorption isotherm -industrial applications of adsorption - applications of surface active agents - detergency-wetting - water repellency- emulsifiers - CMC and defoamers.

Catalysis - general characteristics -types of catalysis -acid -base catalysis - enzyme catalysis -characteristics-Michaelis - Menton equation -effect of temperature on enzyme catalysis - Langmuir- Hinshelwood mechanism for heterogeneous catalysis.

UNIT-III NANO MATERIALS 9

Basics-distinction between nanoparticles and bulk materials - size-dependent properties - nanoparticles - nanocluster – nanorod - nanotube and nanowire - synthesis of nanoparticles - chemical methods -metal nanocrystals by reduction ,solvothermal synthesis, photochemical synthesis, sonochemical synthesisandchemical vapor deposition -physical methods - ball milling ,electrodeposition - biogenic synthesis - properties and applications.

UNIT-IV HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS 9

Heterocyclic compounds-synthesis and reactions of pyrrole -furan - thiophene- pyridine- quinoline-isoquinoline.
Terpenoids- Isolation - Isoprene rule-structural elucidation of citral and menthol.

UNIT-V POLYMERS 9

Polymers-definition - polymerization - types - addition and condensation polymerization - free radical polymerization mechanism - effect of structure on the properties of polymers - strength, plastic deformation, elasticity and crystallinity - plastics - preparation - properties and uses of PVC, teflon, polycarbonate, polyurethane, nylon-6,6, PET,KEVLAR-Green polymers-Introduction –poly lactic acid (PLA)

Total Contact Hours : 45

Text books:

- P. C. Jain and Monika Jain, “Engineering Chemistry”, DhanpatRai Publishing Company (P) LTD, New Delhi, 2015

- Bahl B. S., and Arun Bahl, "A Text Book of Organic Chemistry", S. Chand, New Delhi, 2016.

Reference books:

- R.D. Madan, "Modern Inorganic Chemistry", S. Chand, New Delhi, 2012
- I L Finar "Organic Chemistry" ELBS (1994)
- Gowarikar V. R., Viswanathan N.V. and Jayadev Sreedhar, ―Polymer Science‖, New
- B.S. Murthy, P.Shankarand others,"Text book of Nano-science and nanotechnology", University Press, IIM.

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 10 experiments) 30

1 Estimation of mixture of acids by conductometry
2 Estimation of copper / ferrous ions by spectrophotometry
3 Estimation of acid by pH metry.
4 Estimation of alkalinity by indicator method.
5 Estimation of chloride by argentometric method
6 Determination of total, temporary and permanent hardness by EDTA method.
7 Estimation of DO by winkler's method
8 Estimation of sodium and potassium in water by flame photometry
9 Determination of corrosion rate on mild steel by weight loss method
10 Determination of molecular weight of a polymer by viscometry method.
11 Verification of adsorption isotherms (acetic acid on charcoal)
12 Phase change in a solid.
13 Preparation of simple drug
14 Determination of rate constant of a reaction
15 Determination of distribution coefficient
16 Preparation of Thiokol rubber.

PERIODS:30

TOTAL PERIODS:75

Course outcomes:

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

- Be conversant with basics of molecule formation and interactions
- measure molecular/bulk properties like absorbance, molecular weight, DO and chloride
- Apply the knowledge of surface chemistry in practical and industrial applications
- Be familiar with structure and properties of natural products
- Be assertive on various types of polymers and their properties including green polymers

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CY19141.1	2	1	1	2	1	1	2	1	1	-	1	1	2	2	1
CY19141.2	2	1	2	3	2	3	3	1	2	-	2	2	2	2	2
CY19141.3	3	3	3	3	3	3	3	3	3	-	3	3	3	3	3
CY19141.4	2	2	3	2	3	2	2	2	2	-	3	2	3	3	2
CY19141.5	3	3	3	3	3	3	2	2	3	-	3	2	3	2	3
Average	2.4	2.0	2.4	2.6	2.4	2.4	2.4	1.8	2.2	-	2.4	2.0	2.6	2.4	2.2

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE19211	PROBLEM SOLVING AND PROGRAMMING IN PYTHON	ES	1	0	4	3

(with effect from 2021 batch onwards)

(Common to AERO, AUTO, BME, BT, CHEMICAL, CIVIL, EEE, ECE, FT, MECH, MCT, R&A)

Course Objectives:

- To understand computers, programming languages and their generations and essential skills for a logical thinking for problem solving.
- To write, test, and debug simple Python programs with conditionals, and loops and functions
- To develop Python programs with defining functions and calling them
- To understand and write python programs with compound data- lists, tuples, dictionaries
- To search, sort, read and write data from/to files in Python.

List of Experiments

1. Study of algorithms, flowcharts and pseudocodes.
2. Introduction to Python Programming and Demo on Python IDLE / Anaconda distribution.
3. Experiments based on Variables, Datatypes and Operators in Python.
4. Coding Standards and Formatting Output.
5. Algorithmic Approach: Selection control structures.
6. Algorithmic Approach: Iteration control structures.
7. Experiments based on Strings and its operations.
8. Experiments based on Lists and its operations.
9. Experiments based on Tuples and its operations.
10. Experiments based on Sets and its operations.
11. Experiments based on Dictionary and its operations.
12. Functions: Built-in functions.
13. Functions: User-defined functions.
14. Functions: Recursive functions.
15. Searching techniques: Linear and Binary.
16. Sorting techniques: Bubble and Merge Sort.
17. Experiments based on files and its operations.

Contact Hours : 75

Course Outcomes:

On completion of the course, students will be able to:

- Understand the working principle of a computer and identify the purpose of a computer programming language and ability to identify an appropriate approach to solve the problem.
- Write, test, and debug simple Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Apply searching, sorting on data and efficiently handle data using flat files.

Text Books:

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/)
2. Guido Van Rossum and Fred L. Drake Jr, An Introduction to Python - Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books:

1. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013.
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC, 2013.

Platform Needed: Python 3 interpreter for Windows/Linux

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
GE19211.1	2	2	2	2	1	-	-	-	1	1	1	1	3	3	-
GE19211.2	2	1	1	1	1	-	-	-	-	-	1	1	3	2	-
GE19211.3	1	1	2	1	2	-	-	-	-	-	1	1	2	3	2
GE19211.4	2	2	3	2	2	-	-	-	-	-	2	1	2	2	2
GE19211.5	2	2	3	2	3	-	-	-	-	-	2	1	2	2	2
Average	**1.8**	**1.6**	**2.2**	**1.6**	**1.8**	**-**	**-**	**-**	**1**	**1**	**1.4**	**1**	**2.4**	**2.4**	**2**

GE19202 BASIC CIVIL AND MECHANICAL ENGINEERING Category L T P C
ES 3 0 0 3

Objectives: Students will be able

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

UNIT-I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 9

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society – Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering. .

UNIT-II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. Civil Engineering Materials:Bricks – stones – sand – cement – concrete – steel - timber - modern materials.

UNIT-III BUILDING COMPONENTS AND STRUCTURES 9

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way

UNIT-IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants - 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 – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines,

Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT-V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

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 Contact Hours : 45

Course Outcomes: On the successful completion of the course, students will be able to :

- Appreciate the Civil and Mechanical Engineering components of Projects.
- Explain the usage of construction material and proper selection of construction materials.
- Measure distances and area by surveying
- Identify the components used in power plant cycle.
- Demonstrate working principles of petrol and diesel engine.

Text Book (s):

1 Shanmugam and Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill PublishingCo.,NewDelhi,2018

Reference Books(s) / Web links:

1 Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

2 Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.2013.

3 Sadhu Singh.,"Basic Mechanical Engineering", S.Chand Publication 2009

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE19201.1	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-
GE19201.2	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-
GE19201.3	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-
GE19201.4	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-
GE19201.5	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-
Average	3	0	2	0	-	-	-	-	0	0	0	1	-	-	-

BT19201 BIOCHEMISTRY Category L T P C
PC 3 0 0 3

Course objectives:
This course will enable the students

- 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

Proteins: Structure and properties of amino acids - biologically significant peptides and proteins - hierarchy of structural 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 INTRODUCTION TO 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 (Michaelis–Menten equation Km, Vm)) 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 and palmitic acid oxidation.

Total Contact Hours : 45

Course outcomes:

Upon 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.
- Realize the importance of ATP and other high energy compounds.

Text books:

- Hames D, Hooper N., BIOS Instant notes - Biochemistry. 4thedition, Garland Science,Taylor and Francis group, New York and London,2011.
- Pamela C Champe, Richard A. Harvey, Lippincott's illustrated reviews, Biochemistry, Third Edition, Lippincott Williams & Wilkins2005.
- 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, February2015.

Reference books:

- Lehninger A.L., Nelson D.L. and Cox M.M. Principles of Biochemistry, 6thedition, CBS publishers and distributors,2012.
- Burtis&Ashwood W.B. Tietz Textbook of Clinical chemistry, Volume 564, SaundersCompany,1999.
- LubertStryer W.H. Biochemistry, 5thRevised edition Freeman and company, New York,2002.
- Donald Voet& Judith G. Voet. Biochemistry. John Wiley and Sons, Inc. Rama Rao Textbook of Biochemistry, 4th Edition, Deb. Textbook of Biochemistry, November2010.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19201.1	3	3	-	-	-	-	-	1	1	3	1	3	3	3	3
BT19201.2	2	2	3	-	-	-	-	1	1	3	2	3	3	3	3
BT19201.3	3	3	1	3	3	3	3	1	-	3	2	3	3	3	3
BT19201.4	2	2	-	2	2	-	-	3	1	3	1	3	3	3	3
BT19201.5	2	2	-	3	3	3	1	1	3	1	-	3	3	3	3
Average	2.4	2.4	0.8	1.6	1.6	1.2	0.8	1.4	1.2	2.6	1.2	3	3	3	3

MC19102 INDIAN CONSTITUTION AND FREEDOM MOVEMENT

Category	L	T	P	C
MC	3	0	0	0

Course objectives:

To inculcate the values enshrined in the Indian constitution

- To create a sense of responsible and active citizenship
- To know about Constitutional and Non- Constitutional bodies
- To understand sacrifices made by the freedom fighters.

UNIT I INTRODUCTION **9**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT **9**

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT-III STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY **9**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, ,Village level: Role of Elected and Appointed officials.

UNIT-IV CONSTITUTIONAL FUNCTIONS AND BODIES **9**

Indian Federal System – Center – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies..

UNIT-V INDIAN FREEDOM MOVEMENT **9**

British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-I**ndian Freedom Struggle under Mahatma Gandhi-**Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition

Total Contact Hours : 45

Course outcomes:

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

- Understand the functions of the Indian government
- Understand and abide the rules of the Indian constitution.
- Gain knowledge on functions of state Government and Local bodies
- Gain Knowledge on constitution functions and role of constitutional bodies and non constitutional bodies
- Understand the sacrifices made by freedom fighters during freedom movement

Text books:

- Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21st ed 2013

- Bipan Chandra, History of Modern India, Orient Black Swan, 2009
- Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016
- Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.2nd ed, 2014
- P K Agarwal and K N Chaturvedi , Prabhat Prakashan, New Delhi, 1st ed , 2017

Reference books:

- Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
- U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC19102. 1	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-
MC19102. 2	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-
MC19102. 3	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-
MC19102. 4	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-
MC19102. 5	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-
Average	-	-	-	-	-	2	-	1	1	1	-	2	-	-	-

BT19211 BIOCHEMISTRY LABORATORY

Category	L	T	P	C
PC	0	0	4	2

Course 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.

List of Experiments

1. General guidelines for working in biochemistry lab. Accuracy, precision, sensitivity and specificity (theory)
2. Demonstration of proper use of volume and weight measurement devices.
3. Validation of Beer's-Lambert Law by using $KMnO_4$/$K_2Cr_2O_7$
4. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
5. Quantitative estimation of aminoacids using Ninhydrin-distinguishing amino from imino group.
6. Protein estimation by colorimetric and spectroscopic methods.
7. Protein estimation by Bradford method.
8. Estimation of Creatinine in biological sample and its significance.
9. Extraction of lipids and analysis by TLC
10. Estimation of glucose by DNS method.
11. Demonstration of GOD-POD assay of glucose.
12. Separation of phytochemicals using Paper/Column Chromatography
13. Extraction and assay of acid phosphatase from potato.

Contact Hours : 60

Course outcomes:

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

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

Text books:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19211.1	3	2	-	-	-	-	-	-	-	-	-	1	2	1	3
BT19211.2	3	2	2	1	1	-	-	-	-	-	-	1	3	2	3
BT19211.3	3	2	2	1	1	-	-	-	-	-	-	2	3	2	2
BT19211.4	3	2	2	2	2	-	-	-	-	-	-	1	2	2	2
BT19211.5	2	2	3	1	2	2	2	1	-	-	-	2	3	2	2
Average	2.8	2	1.8	1	1.2	0.4	0.4	0.2	-	-	-	1.4	2.6	1.8	2.4

MA19353 TRANSFORMS AND NUMERICAL METHODS
Common to III sem. B.E. Electrical and Electronics Engineering and B.Tech. Biotechnology & Food Technology

Category BS | **L T P C** **3 1 0 4**

Objectives:

- To introduce Fourier series and Z transforms to solve problems that arise in the field of Engineering.
- To provide procedures for solving numerically different kinds of problems occurring in the field of Engineering and Technology.

UNIT-I FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT-II Z - TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

UNIT-III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

Newton Raphson method – secant method – Gauss Jordan method – Iterative method of Gauss Seidel –Eigen value of a matrix by power method and by Jacobi method for symmetric matrix.

UNIT-IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **12**

Curve fitting ($y= a+ bx$, $y = a+bx+cx^2$)-Lagrange's interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules.

UNIT-V NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS **12**

Taylor's series method – Modified Euler's method – Fourth order Runge - Kutta method for solving first order equations – Finite difference methods for solving second order equations- Finite difference solution of one dimensional heat equation by explicit and implicit methods - Two dimensional Laplace equation.

Total Contact Hours : 60

Course Outcomes:

On completion of course students will be able to

- develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- solve difference equations using Z – transforms that arise in discrete time systems.
- Solve algebraic equations and eigen value problems that arise during the study of engineering problems.
- use interpolation methods to solve problems involving numerical differentiation and integration.
- solve differential equations numerically that arise in course of solving engineering problems.

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2012.
3. Kandasamy P., Thilagavathi and K. Gunavathi., "Statistics and Numerical Methods" , S. Chand & Company Ltd. (2010).

Reference Books / Web links:

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
4. Chapra S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.
5. Veerarajan T., Ramachandran T., 'Numerical Methods with Programs in C and C++' Tata McGraw Hill., 2007.
6. Jain M.K., Iyengar, S.R., and Jain, R.K., 'Numerical Methods for Scientific and Engineering Computation', New Age Publishers. 6th edition, 2007.
7. Rajaraman V., Computer-Oriented Numerical Methods, Third Edition, Published by PHI Learning Private Limited (2013).

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA19353.1	3	3	3	2	1	-	-	-	-	-	-	1	1	1	2
MA19353.2	3	3	3	2	1	-	-	-	-	-	-	1	1	1	2
MA19353.3	3	3	3	2	2	-	-	-	-	-	1	2	2	1	2
MA19353.4	3	3	3	2	2	-	-	-	-	-	1	2	2	1	2
MA19353.5	3	3	3	3	2	-	-	-	-	-	-	2	1	1	2
Average	3	3	3	2.2	1.6	-	-	-	-	-	0.4	1.6	1.4	1	2

BT19301 MICROBIOLOGY

Category	L	T	P	C
PC	3	0	0	3

Objectives:

- To inculcate knowledge on fundamentals of microorganisms and Microscopy
- To learn the structural organization, morphology and reproduction of microbes
- To acquire knowledge on basic principles of microbial culture, growth and its metabolism
- To understand the principles of sterilization technique and chemotherapeutic agents
- To enable them to know about the various applications of microbes in biotechnology

UNIT-I INTRODUCTIONTOMICROBIOLOGY 9

History and Scope of microbiology, Classification and Nomenclature of microorganisms, Microscopy: Bright field, Dark field, Phase contrast, Fluorescent and Electron microscopy. Stains and Staining techniques: Simple staining, Differential staining (Gram & Acid fast), Special staining (Capsular, Flagellar& Endospore).

UNIT-II MICROBES- STRUCTUREANDREPRODUCTION 9

Structural organization and multiplication of Bacteria, General characteristics and replication of Viruses, General structure and reproduction of Fungi (Mould& Yeast), Algae and Actinomycetes. *Mycoplasma pneumoniae* and Bacteriophages.

UNIT-III MICROBIAL NUTRITION, GROWTHANDMETABOLISM 9

Nutritional requirement and classification of microorganisms based on physiological factors, Culture media (defined, complex, selective, differential, and enriched), Growth: Definition, Growth curve and the mathematics of growth. Quantification of microbial growth: (Direct and Indirect methods), Microbial metabolism: aerobic and anaerobic bioenergetics

UNIT-IV CONTROLOFMICROORGANISMS 9

Sterilization (Physical and Chemical) – Definition, Types, Mode of action, Sterility control and its Applications. Antimicrobial chemotherapy – Antibiotics (Anti bacterial, antifungal and antiviral) – Classification and its mode of action – Sensitivity tests and Development of drug resistance and its mechanisms.

UNIT-V APPLIED MICROBIOLOGY 9

Application of microbial biotechnology- Biogas Production, Bioremediation, Bio fertilizers, Bio pesticides, Bioleaching, Vermicomposting, Biosensors.

Total Contact Hours : 45

Course Outcomes: The students will be able to

- Gain the knowledge on the principles of microscopes
- Understand and differentiate the microorganisms based on its morphology
- Formulate and design the culture media for the growth of microorganisms
- Analyze and apply the appropriate sterilization technique to control the microorganisms
- Relate and design the process of industrial biomass production using microorganisms
- Identify and address the needs in the microbial biomass production industrial

Text Book(s):

1. StanierRY,IngrahmJI,WheelisMLandPainterPR.―GeneralMicrobiology.‖5thedition,McMillan Press.1986
2. Ananthanarayanan, R. and C.K. JayaramPaniker, ―Textbook of Microbiology‖,4th Edition, Orient Longman, 1990.
3. Schlegel,H.G.―GeneralMicrobiology‖,7thEdition,CambridgeUniversityPress,1993.

Reference Books(s) / Web links:

1. Pelczar MJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, NewDelhi,
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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19301.1	2	1	2	3	3	2	2	2	3	3	2	2	3	2	2
BT19301.2	2	2	2	3	3	2	3	2	3	3	2	3	3	3	2
BT19301.3	1	2	2	3	3	2	3	2	3	3	2	3	2	3	2
BT19301.4	2	2	1	3	2	2	3	2	3	3	2	3	3	2	2
BT19301.5	2	2	3	3	3	3	3	3	3	3	3	3	2	3	2
Average	1.8	1.8	2.0	3.0	2.8	2.2	2.8	2.2	3.0	3.0	2.2	2.8	2.6	2.8	2.0

BT19302 ENZYME TECHNOLOGY AND BIOTRANSFORMATIONS Category L T P C
PC 3 0 0 3

Objectives: To enable the students

- Learn enzyme reactions and its characteristics along with the extraction, 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

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 CHARACTERIZATION AND APPLICATION OF ENZYMES 12

Isolation and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes – Development of enzymatic assays. Application of enzymes in food, leather and pharmaceutical industry, Industrial applications of hyperthermophilic and psychrophilic enzymes.

UNIT-V BIOTRANSFORMATION REACTIONS 6

Enzymes role in reduction reactions – Aldehydes, Ketones, Baeyer-Villiger Oxidation, Enzymes in organic synthesis – esters, amide, peptide – Modified and Artificial Enzymes – Catalytic antibodies.

Total Contact Hours : 45

Course Outcomes:

- Students will gain knowledge on enzyme classification and enzyme reactions.
- Students will be able to understand the theoretical and practical aspects of enzyme kinetics.
- Students will be able to comprehend the immobilization process and its application in various industries
- Students will carry out enzyme isolation , purification and characterization.
- Students will be able to design biotransformation reactions and production of novel enzymes.

Text Book(s):

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

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19302.1	2	1	2	3	1	3	-	-	-	-	-	3	2	1	3
BT19302.2	3	3	2	3	2	-	-	-	-	-	-	3	3	3	3
BT19302.3	3	3	3	3	3	3	2	-	2	-	-	3	3	3	3
BT19302.4	3	3	3	3	3	3	3	-	2	-	2	3	3	3	3
BT19302.5	3	3	3	3	3	3	3	-	2	-	-	3	3	3	3
Average	2.8	2.6	2.6`	3	2.4	2.4	1.6	0	1.2	0	0.4	3	2.8	2.6	3

BT19303 **CELL BIOLOGY** **Category L T P C**
PC 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. Cell viability – MTT assay.

Total Contact Hours : 45

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 muscular systems.
- 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 Book(s):

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.

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19303.1	1	-	-	3	-	-	2	2	3	3	1	3	3	2	3
BT19303.2	2	3	3	3	3	2	2	2	3	3	2	3	3	3	3
BT19303.3	2	2	2	3	3	2	2	2	3	3	3	2	2	2	2
BT19303.4	2	3	2	3	3	2	2	2	3	3	2	3	3	3	2
BT19303.5	3	3	2	2	3	3	2	3	3	3	2	3	3	3	2
Average	2	2.2	1.8	2.8	2.4	1.8	2.0	2.2	3.0	3.0	2.0	2.8	2.8	2.6	2.4

BT19304 STOICHIOMETRY AND THERMODYNAMICS Category L T P C

ES 3 2 0 4

Objectives:

- To learn the fundamentals of units and conversion
- To understand the concepts in material balance for different unit operations
- To gain knowledge in the concepts of energy balance equations
- To endow the students with the thermodynamic relations and concept of partial molar properties
- To solve VLE calculations for binary system

UNIT-I INTRODUCTION 12

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

UNIT-II CONCEPTS INMATERIALBALANCES 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, mixing, Recycle and Bypass illustration. Chemical Reaction-Limiting, excess component, Fractional conversion and yield, Combustion Reactions.

UNIT-III CONCEPTS INENERGY BALANCES 12

Energy balance equation for open systems, closed system, sensible and latent heat calculations - Application of energy balance in Bioprocesses

UNIT-IV PROPERTIESOFFLUIDS AND SOLUTION THERMODYNAMICS 12

Scope of thermodynamics, fundamental concepts in thermodynamics, Maxwell's relations and applications; Partial molar properties - determination of partial molar properties; Concepts of chemical potential and fugacity; ideal and non-ideal solutions; activity coefficient; Gibbs Duhem equation.

UNIT-V PHASEEQUILIBRIA 12

Criteria for phase equilibria, Activity coefficient Composition models, 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; Binary liquid- liquid equilibrium diagrams- applications.

Total Contact Hours : 60

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

- Learn the fundamentals of the units and conversions
- Solve the material balance problems for different unit operations
- Solve energy balance equations for different systems
- Apply the concepts of partial molar properties in solutions
- Determine the VLE composition for binary systems.

Text Book(s):

1 Bhatt, B.I. and S.M.Vora–Stoichiometry (SIUnits) ‖, 3rd Edition, Tata McGraw Hill, 1996.

2 McCabe,W.L.,J.C.SmithandP.Harriot—UnitOperationsofChemicalEngineering‖,6th Edition,Mc Graw Hill,2001

3 Narayanan K.V.–AText Book ofChemical EngineeringThermodynamics ‖, PHI, 2003.

4 Y.V.C.Rao , Chemical Engineering Thermodynamics' , University Press (India) Ltd., Hyderabad 1997

Reference Books(s) / Web links:

1 Himmelblau, D.M. –Basic principles and calculations in Chemical Engineering ‖, 6th Edition, PHI, 2006.

2 Smith J.M., Van Ness H.C., and Abbot M.M. –Introduction to Chemical Engineering Thermodynamics‖, VIth Edition. Tata McGraw-Hill,2003.

3 Coulson,J.M. and etal.–Coulson &Richardson's Chemical Engineering‖, 6thEdition,Vol.I&II, Butterworth – Heinman (an imprint of Elsevier),2004.

4 SandlerS.I.–Chemical and Engineering Thermodynamics‖, John Wiley, 1989.

Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green , Marylee Z. Southard, Imprint: McGraw-Hill Education.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19304.1	3	3	1	-	-	-	-	-	1	-	3	3	-	-	3
BT19304.2	3	3	3	3	2	-	-	-	1	-	2	3	-	-	3
BT19304.3	3	3	3	3	2	-	-	-	1	-	2	3	-	-	3
BT17904.4	3	3	3	3	1	1	1	-	1	-	2	3	-	-	3
BT17904.5	3	3	3	3	1	1	1	-	1	-	2	3	-	-	3
Average	3	3	2.6	2.4	1.2	0.4	0.4	-	1	-	2.2	3	-	-	3

BT19305	BASIC INDUSTRIAL BIOTECHNOLOGY	Category	L	T	P	C
		PC	3	0	0	3

Objectives:

- To impart knowledge on industrial fermentation technology
- To understand the fundamentals of upstream and downstream process in fermentation
- To design fermentation process for the production of various primary metabolites
- To learn new technology for the production of secondary metabolites
- To develop skills for bulk production of commercially and therapeutically important bioproducts

UNIT-I INTRODUCTION TO INDUSTRIAL FERMENTATION TECHNOLOGY 8

History and scope of Fermentation technology, Fermentor and its types, Biochemistry of Fermentation Process, Types of fermentation process- Batch, Continuous and Fed Batch, Submerged fermentation, Solid state fermentation, products from plant, animals and microorganisms.

UNIT-II UPSTREAM AND DOWNSTREAM PROCESS 9

Basic concepts of Upstream- Screening & Preservation of strains, Preparation of inoculum, Media formulation and Sterilization. Downstream process in fermentation, Process flow sheet, Computer control of fermentor.

UNIT-III PRODUCTION OF PRIMARY METABOLITES 8

Production of commercially important primary metabolites like organic acids (Citric acid and acetic acid), amino acids (Glutamic acid and Lysine), Enzymes (Amylase and Protease) and Ethyl alcohol.

UNIT-IV PRODUCTION OF SECONDARY METABOLITES 8

Production of commercially important secondary metabolites: Antibiotics (Penicillin, Streptomycin & Tetracycline), Vitamins (B12, B2 & C) and Biotransformation- Steroids.

UNIT-V PRODUCTION OF OTHER MODERN BIOTECHNOLOGY PRODUCTS 12

Food products (Cheese & SCP & Mushroom culture), Alcoholic beverages (Beer & Wine), Biopesticides, Biofertilizers, Biopreservatives (Nisin), Biopolymers (Xanthan gum & PHB), Recombinant therapeutic & diagnostic proteins (Insulin & Monoclonal antibodies).

Total Contact Hours : 45

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

- Gain knowledge on fundamentals of fermentation technology
- Apply appropriate techniques of upstream and downstream process for the bio product production
- Formulate and design the production process of primary metabolites
- Analyze and apply the knowledge of fermentation techniques for the production and recovery of secondary metabolites
- Design and develop the process for the production of modern biotechnology products

Text Book(s):

1. Patel, AH- Industrial Microbiology. 2nd edition, Trinity press Lakshmi publication (P) Ltd., 2017.
2. Satyanarayana, U. ―Biotechnology‖ Books & Allied (P) Ltd., 2005.
3. Kumar, H.D. ―A Textbook on Biotechnology‖ IInd Edition. Affiliated East West Press Pvt. Ltd., 1998.
4. Balasubramanian, D. et. al., ―Concepts in Biotechnology‖ Universities Press Pvt.Ltd., 2004.
5. Ratledge, Colin and Bjorn Kristiansen ―Basic Biotechnology‖ IInd Edition Cambridge University Press, 2001
6. Dubey, R.C. ―A Textbook of Biotechnology‖ S.Chand & Co. Ltd., 2006.

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19305.1	3	-	-	-	-	-	-	-	-	-	-	2	3	-	-
BT19305.2	-	3	-	-	2	-	-	-	-	-	-	3	-	3	-
BT19905.3	-	3	3	3	3	-	-	-	2	-	-	3	-	3	-
BT19305.4	-	3	3	3	3	-	2	-	-	-	-	3	-	3	-
BT19305.5	-	-	3	3	3	-	3	-	-	-	-	3	3	3	3
Average	3	3	3	3	2.2	-	2.5	-	2	-	-	2.8	3	3	3

BT19311 MICROBIOLOGY LABORATORY

Category	L	T	P	C
PC	0	0	3	1.5

Objectives:

- To Train students in the proper use and maintenance of the Microbiology laboratory with emphasis on observation microbes by staining techniques
- To demonstrate appropriate methods to estimate the number of microorganisms in a sample
- To demonstrate an understanding of environmental effects on bacterial growth
- To familiarize the student on biochemical tests to identify microbes.
- Provide students with a hands-on familiarity with basic research procedure and associated critical and investigative thinking skills utilizing identification of unknown microorganism from specimens.

List of Experiments

1. Laboratory Safety
2. Introduction to sterilization techniques
3. Microscopy: Working and its principles
4. Culture media: Media preparation- Broth, Agar (deep, slant and plate)
5. Culture techniques: Isolation- Streak plate, Pour plate, spread plate, Slant and Stab

6	Quantification of Microbes from soil, water, and milk: Serial dilution, Pour plate, Spread plate and streak plate method
7	Staining: a. Simple Staining b. Gram's staining c. Capsule Staining d. Spore Staining
8	Motility test:- Hanging drop method
9	Biochemical tests: IMViC test, Catalase, Oxidase,TSI and urease test.
10	Growth Curve
11	Effect of pH, Temperature, UV radiation on Microbial Growth
12	Antibiotic Sensitivity test
13	Effect of Disinfectants- Phenol Coefficient test
14	Micrometery
Total Contact Hours	**: 45**

Course Outcomes:

- The student will be able to identify Microorganism through microscope
- The student will be able to prepare a suitable media and cultivate the microbes by different techniques.
- The student can able to isolate and identify microbial strain by staining and biochemical tests
- The students can able to find out antibiotic susceptibility and resistance prototype of pathogens.
- The student will be able to check the role of physiological factors on Microbial growth and multiplication.

Web links for virtual lab (if any)

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19311.1	2	2	3	3	3	2	2	2	3	3	2	3	3	2	2
BT19311.2	2	1	2	3	3	3	3	2	3	3	2	3	2	3	2
BT19311.3	1	2	3	2	3	2	3	2	3	3	2	3	3	2	2
BT19311.4	1	2	3	3	3	2	3	2	3	3	3	3	2	3	2
BT19311.5	2	2	2	3	2	2	2	2	3	3	3	3	2	3	2
Average	1.6	1.8	2.6	2.8	2.5	2.2	2.6	2.0	3.0	3.0	2.4	3.0	2.4	2.6	2.0

BT19312 BASIC BIOTECHNOLOGY LAB Category L T P C

PC 0 0 3 1.5

Objectives:

- To Strengthen the basic concepts in biology through practical applications.

List of Experiments

1. Validation of properties of water – surface tension, capillary action, solubility, viscosity, thermal conductivity.
2. Osmosis and Tonicity – Hyper, Hypo and Isotonicities – Membranes - role in maintenance of pH ionic concentration etc.
3. Extraction of DNA from plant sources – structure and importance of nucleic acids
4. Synthesis of Aspirin – Prostaglandins
5. Isolation of lycopene from tomato paste - Role of natural antioxidants in food preservation
6. Preparation of 5,10,15,20-tetra kisphenyl porphyrin
7. Determination of pKa value of 4-dinitrophenol by using absorption spectrometer – special reference to importance of pH, biological buffers, Henderson – Hassel Baulch equation etc.
8. Estimation of sulphate by nephelometry – principle, methodology and applications.
9. Estimation of proteins/DNA by UV visible spectrometer - principles of spectrophotometry and its applications in biology.
10. Hydrolysis of sucrose – concept of optical activity, inversion, mutarotation etc. and applications in industry.
11. Tryphan Blue Assay for cell viability – cytotoxicity.
12. Staining for different stages of mitosis in AlliumCepa (Onion) – Mitosis, Meiosis and their significance

Total Contact Hours : 45

Course Outcomes:

- Understand the unique properties of water and apply them in multiple areas such as Biochemistry Food Processing Cell Biology, Tissue culture etc.
- Design methods to synthesise and purify organic/bio organic molecules and study their applications.
- Validate basic technique in biotechnology and their use in biological research

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19312.1	3	3	1	2	1	1	2	1	1	2	1	3	3	2	1
BT19312.2	3	3	3	3	2	2	2	2	2	2	2	3	3	3	3
BT19312.3	3	3	3	3	2	2	2	2	2	2	2	3	3	3	3
Average	3	3	2.3	2.6	1.6	1.6	2	1.6	1.6	2	1.6	3	3	2.6	2.3

MA19453 PROBABILITY AND STATISTICS Category L T P C

Common to IV sem. B.Tech. Biotechnology and Food Technology BS 3 1 0 4

Objectives:

- To provide the required mathematical support in real life problems and develop probabilistic models which can

be used in several areas of science and engineering.
- To provide the required skill to apply the statistical tools in Engineering problems.

UNIT-I ONE – DIMENSIONAL RANDOM VARIABLE 12

Discrete and continuous random variables – Moments – Moment generating function –Binomial, Poisson, Geometric, Uniform, Exponential, and Normal distributions.

UNIT-II TWO - DIMENSIONAL RANDOM VARIABLES 12

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

UNIT-III TESTING OF HYPOTHESIS 12

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 12

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

UNIT-V STATISTICAL QUALITY CONTROL 12

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

Total Contact Hours : 60

Course Outcomes:

On completion of 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 Veerarajan T, '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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA19453.1	3	3	3	2	2	-	-	-	-	-	1	2	1	1	2
MA19453.2	3	3	3	2	2	-	-	-	-	-	1	2	1	1	2
MA19453.3	3	3	3	3	3	-	-	-	-	-	2	3	2	2	3
MA19453.4	3	3	3	3	3	-	-	-	-	-	2	3	2	2	3
MA19453.5	3	3	3	3	3	-	-	-	-	-	2	3	2	2	3
Average	3	3	3	2.6	2.6	-	-	-	-	-	1.6	2.6	1.6	1.6	2.6

BT19401 ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY Category L T P C

ES 3 0 0 3

Objectives:
- To gain knowledge on the principles of spectrometry and optical instruments.

- To learn the theoretical and practical aspects of molecular spectroscopy.
- To identify the suitable structure elucidation and interaction techniques.
- To know different separation methodsused in Biotechnology.
- Tounderstand various advanced analytical techniques.

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 Ratio– Types of Optical Instruments

UNIT-II SPECTROSCOPIC TECHNIQUES - I 9

Beer's Law – UV-Visible Light Spectroscopy – Instrumentation – Applications – Light Scattering –Turbidometric and Nephalometric Analysis – Fluorescence Spectroscopy – Instrumentation – Applications – Fourier Transform Infrared Spectroscopy – Instrumentation – Applications – Raman Spectroscopy – Instrumentation – Applications

UNIT-III IIISPECTROSCOPIC TECHNIQUES - II 9

Nuclear Magnetic Resonance – Theory – Instrumentation – Applications –Electron Paramagnetic Resonance – Instrumentation – X-Ray Diffraction –Theory – Instrumentation – Applications –Mass Spectrometer –Ion Sources – Applications – Atomic Absorption Spectroscopy –Theory – Instrumentation – Applications.

UNIT-IV 9

SEPARATION TECHNIQUES

General principles of chromatography – Chromatographic Performance Parameters – Ideal Separation – Band Broadening and Optimization – HPLC – Gas Chromatography – Principles of Electrophoresis – Gel Electrophoresis – Capillary Electrophoresis.

UNIT-V ADVANCED ANALYTICAL TECHNIQUES 9

Theory, Instrumentation and Applications of: Thermogravimetric Analysis - Differential Thermal Analysis - Differential Scanning Calorimetry – Atomic Force Microscopy – Scanning Tunneling Microscope –Brunauer Emmett Teller Analysis – Vibrating Sample Magnetometer Analysis.

Total Contact Hours : 45

Course Outcomes: At the end of the course the students will be able to

- demonstrate the principle of spectrometry and the optical instruments
- assess the theoretical and practical aspects of molecular spectroscopy.
- detect appropriate techniques for structure elucidation and interactions.
- Comprehend various separation techniques in biotechnology.
- apply different techniques to analyse the properties of the samples

Text Book(s):

1. Wilson, K and Walker, J - Principles and Techniques of Biochemistry and Molecular Biology, VIIth Edition, Cambridge University Press, 2010.
2. Skoog, D.A. F. James Holler, and Stanky, R.Crouch ―Principles of Instrumental Analysis, VIth Edition,Thomson Brooks/Cole,2007.
3. Willard, Hobart, etal., ―Instrumental Methods of Analysis. VIIth Edition, CBS,1986.
4. Braun, Robert D. ―Introduction to Instrumental Analysis. Pharma Book Syndicate,1987.

Reference Books(s) / Web links:

1. Sharma, B.K. ―Instrumental Methods of Chemical Analysis: Analytical Chemistry‖ Goel Publishing House, 1972.
2. Haven,MaryC.,etal.,―LaboratoryInstrumentation―.IVthEdition,JohnWiley,1995.
3. https://lecturenotes.in/materials/14302-note-of-instrumental-methods-of-analysis-by-rishab-sahoo
4. https://youtu.be/LLPMxBB9hRw
5. https://youtu.be/2oPUyIbPxLo (Knowbee)

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19401.1	3	3	3	3	3	-	1	3	-	-	3	3	3	3	3
BT19401.2	3	3	3	3	3	-	1	1	1	1	3	3	3	3	3
BT19401.3	3	3	3	3	3	3	1	1	1	1	3	3	3	3	3
BT19401.4	3	3	3	3	3	3	-	1	1	1	3	3	3	3	3
BT19401.5	3	3	3	3	3	3	1	1	1	1	3	3	3	3	3
Average	3	3	3	3	3	3	1	1.4	1	1	3	3	3	3	3

BT19402 FLUID MECHANICS AND HEAT TRANSFER Category L T P C

ES 3 1 0 3

Objectives:

- To impart knowledge about the fluid statics and dynamics
- To endow the students with types of valves and pumps used in industries
- To study the mechanism of heat transfer by conduction
- To inculcate the heat flow mechanism by convection
- To design heat exchange equipments

UNIT-I FLUID PROPERTIES & FLUID MECHANICS 9

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

UNIT-II FLOW OF FLUID THROUGH PACKINGS 9

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

UNIT-III CONDUCTION HEAT TRANSFER 9

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

UNIT-IV CONVECTION HEAT TRANSFER 9

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

UNIT-V HEAT EXCHANGERS 9

Heat exchanger- overall heat transfer coefficients; design of heat exchangers; NTU concept; Evaporators-single effect- mass and enthalpy balances.

Total Contact Hours : 45

Course Outcomes: Upon the completion of the course, Students will be able to

- Solve the problems related to fluid flow
- Select various valves and pumps for its application in industries
- Resolve problems for heat flow by conduction for various geometries
- Elucidate the convective heat transfer problems
- Design heat exchanger equipments

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19402.1	3	3	2	2	-	-	-	-	-	-	2	3	-	--	3
BT19402.2	3	3	2	-	-	-	-	-	-	-	2	3	-	-	3
BT19402.3	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
BT19402.4	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
BT19402.5	3	3	3	3	-	1	1	-	-	-	2	3	-	-	3
Average	3	3	2.6	2.2	-	1.5	1.5	-	-	-	2	3	-	-	3

Text Book(s):

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

2 McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. McGraw Hill. 1993.

3 BinayK.Dutta, Heat transfer: Principles and applications, PHI learning Pvt. Ltd., New Delhi, 1st edition, 2006

Reference Books:

1 Geankoplis C.J. Transport Processes And Unit Operations. Prentice HallIndia.2002.

2 Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green , Marylee Z. Southard, Imprint: McGraw-Hill Education.

BT19403 FOOD BIOTECHNOLOGY Category L T P C

ES 3 0 0 3

Objectives: To enable the students:

- Basic concepts of food biotechnology
- To impart knowledge on various foods and its nutritional values
- Learn the constituents and additives present in the food.
- Gain knowledge about the microorganisms, which spoil food and cause 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, nutrigenetics.

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- Dairy products, Fruits and vegetable products and single cell protein

UNIT-IV FOOD SPOILAGE AND FOOD BORNE DISEASES 9

Food spoilage and its types, Factors responsible for spoilage, spoilage of vegetables, fruits, meat, poultry, beverage

and other food products. Classification of food borne disease-Infections –bacterial and other types; Food intoxications and poisonings – bacterial and non-bacterial

UNIT-V FOOD PROCESSING AND FOOD PRESERVATION **9**

Principles of food preservation, Preservation by high temperature- sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; Preservation by low temperature- frozen storage, freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; Irradiation method of foods. Preservation, Food packing.

Total Contact Hours : 45

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

Text Book(s):

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.

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19403.1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	3
BT19403.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
BT19403.3	2	-	3	-	-	-	-	-	-	-	-	-	3	-	2
BT19403.4	3	3	2	-	-	-	-	-	-	-	3	-	-	2	-
BT19403.5	-	3	2	-	-	-	-	-	-	-	3	-	-	2	-
Average	2.75	3	2.25	-	-	-	-	-	-	-	3	-	3	2	2.6

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
CS19411	PYTHON PROGRAMMING FOR MACHINE LEARNING	ES	1	0	4	3

(with effect from 2021 batch onwards)

(Common to AERO, AUTO, BME, BT, CHEMICAL, CIVIL, EEE, ECE, FT, MECH, MCT, R&A)

Course Objectives:

- To understand the relationship of the data collected for decision making.
- To know the concept of principle components, factor analysis and cluster analysis for profiling and interpreting the data collected.
- To lay the foundation of machine learning and its practical applications.
- To develop self-learning algorithms using training data to classify or predict the outcome of future datasets.

- To prepare for real-time problem-solving in data science and machine learning.

List of Experiments

1. NumPy Basics: Arrays and Vectorized Computation
2. Getting Started with pandas
3. Data Loading, Storage, and File Formats
4. Data Cleaning and Preparation
5. Data Wrangling: Join, Combine, and Reshape
6. Plotting and Visualization
7. Data Aggregation and Group Operations
8. Time Series
9. Supervised Learning
10. Unsupervised Learning
11. Representing Data and Engineering Features
12. Model Evaluation and Improvement

Contact Hours : 75

Course Outcomes:

On completion of the course, the students will be able to:

- Develop a sound understanding of current, modern computational statistical approaches and their application to a variety of datasets.
- Use appropriate packages for analysing and representing data.
- Analyze and perform an evaluation of learning algorithms and model selection.
- Compare the strengths and weaknesses of many popular machine learning approaches.
- Apply various machine learning algorithms in a range of real-world applications.

Text Books:

1. Wes McKinney, Python for Data Analysis - Data wrangling with pandas, Numpy, and ipython, Second Edition, O'ReillyMedia Inc, 2017.
2. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python - A Guide for Data Scientists, First Edition, O'Reilly Media Inc, 2016.

Reference Books:

1. AurélienGéron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media Inc, 2019.

Platform Needed: Python 3 interpreter for Windows/Linux

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CS19411.1	2	2	2	2	1	-	-	-	1	2	-	1	3	3	3
CS19411.2	2	2	1	1	2	-	-	-	-	-	-	1	2	1	3
CS19411.3	2	3	2	1	2	-	-	-	1	1	-	1	2	3	2
CS19411.4	1	1	1	-	1	-	-	-	-	1	1	-	1	2	3
CS19411.5	3	3	2	3	3	-	-	-	2	1	-	1	2	3	3
Average	**2**	**2.2**	**1.6**	**1.75**	**1.8**	**-**	**-**	**-**	**1.33**	**1.25**	**1**	**1**	**2**	**2.4**	**2.8**

MC19301 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Category	L	T	P	C
MC	3	0	0	0

Objectives:

- This course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom are important in modern society with rapid technological advancements and societal disruptions. The course mainly focuses on introduction to Indian knowledge system, Indian perspective of modern science, basic principles of Yoga and holistic healthcare system, Indian philosophical, linguistic and artistic traditions

UNIT-I Introduction To Indian Knowledge System: 9

Basic structure of the Indian Knowledge System –Veda – Upaveda - Ayurveda, Dhanurveda-Gandharvaveda, Sthapathyaveda and Arthasasthra. Vedanga (Six forms of Veda) – Shiksha, Kalpa, Nirukta, Vyakarana, Jyothisha and Chandas- Four Shasthras - Dharmashastra, Mimamsa, Purana and Tharkashastra.

UNIT-II 9

Modern Science And Yoga: Modern Science and the Indian Knowledge System – a comparison - Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga-different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies.

UNIT-III 9

Indian Philosophical Tradition: Sarvadharshan/Sadhdharshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies.

UNIT-IV 9

Indian Linguistic Tradition: Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology –Syntax and Semantics-Case Studies.

UNIT-V 9

Indian Artistic Tradition: Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathya kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies.

Total Contact Hours : 45

Course Outcomes: On completion of the course students will be able to

- Understand basic structure of the Indian Knowledge System
- Apply the basic knowledge of modern science and Indian knowledge system in practise
- Understand the importance Indian Philosophical tradition
- Appreciate the Indian Linguistic Tradition.
- Understand the concepts of traditional Indian art forms

Text Book(s):

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014.
2. Swami Jitatman and, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan.
3. Swami Jitatman and, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan.
4. Fritzof Capra, Tao of Physics.
5. Fritzof Capra, The Wave of life.

Reference Books(s) / Web links:

1. VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam.
2. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
3. GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,Vidyanidhi Prakashan, Delhi 2016.
4. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MC19301.1	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19301.2	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19301.3	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19301.4	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19301.5	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
AVERAGE	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-

BT19411 HEAT AND MASS TRANSFER LABORATORY Category L T P C

ES 0 0 3 1.5

Objectives:

- To conduct experiments using flow measuring devices
- To perform characteristic studies on centrifugal pumps
- To carryout experiments on separation processes
- To perform mass transfer studies on diffusion of binary mixtures
- To study the effect of operating variables of heat exchanger

List of Experiments

1. Flow measurement a) Orifice meter b)Venturimeter c) Rotameter
2. Pressure drop- flow in pipes
3. Fluidisation
4. Characteristics of centrifugal pump
5. Filtration- leaf filter
6. Shell and tube heat exchanger
7. Simple and steam distillation
8. HETP in packed distillation
9. Liquid-liquid extraction
10. Adsorption isotherms
11. Diffusion
12. Leaching

Total Contact Hours : 45

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

- Operate different flow meters
- Work on pumps
- Carry out experiments on unit operations like distillation, extraction and adsorption
- Estimate the rate of mass transfer in diffusion
- Identify and solve the problems on heat exchangers

Text Book(s):

1 McCabe W.L., Smith J.C. Unit Operations In Chemical Engineering.5th Edition. McGraw Hill. 1993.
2 BinayK.Dutta, Heat transfer: Principles and applications, PHI learning Pvt. Ltd., New Delhi, 1st edition, 2006

Reference Books(s) / Web links:

1 Geankoplis C.J. Transport Processes And Unit Operations. Prentice HallIndia.2002.
2 Perry's Chemical Engineers' Handbook, 9th Edition, Kindle Edition by Don W. Green , Marylee Z. Southard, Imprint: McGraw-Hill Education.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19411.1	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT19411.2	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT19411.3	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT19411.4	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
BT19411.5	3	3	3	3	-	-	-	-	1	-	2	3	-	-	3
Average	3	3	3	3	-	-	-	-	1	-	2	3	--	-	3

BT19412 FOOD PROCESSING AND PRESERVATION LABORATORY

Category	L	T	P	C
ES	0	0	3	1.5

Objectives:

- This lab should enable the students to apply the theoretical concepts in food processing and preservation, design innovative processing techniques and develop new food products.

List of Experiments

1. Detection of adulteration in food samples- milk and milk products, oils and fats, spices and condiments, honey, cereals, pulses, sugar and confectionary ,MSG and other food products.
2. Preservation techniques:
   a. Preservation of milk by various chemical and natural preservatives
   b. Antimicrobial activity of honey
   c. Antimicrobial activity of turmeric
3. Food processing:
   a. Effect of microwave radiation on processed food samples
   b. Determination of SO_2 in food samples
   c. Determination of Fe^{2+} in food by 2,2 Bipyridyl and colorimetric method
   d. Determination of lead content in food samples
   e. Separation and identification of food colors by chromatography
   f. Shelf life analysis of processed food
4. Food packaging:
   a. Edible packaging materials
5. Nutritional analysis of food
   a. Fat content and Peroxidase value
   b. Dietary fibres
   c. Protein estimation by Kjeldhal method

d. Brix value measurement of sugar by refractive index
e. Vitamin C analysis

6 Instant and innovative food products development - jams, jellies, squashes and other confectionaries.

Total Contact Hours : 45

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

- Analyse and design methods to detect the composition and quality of various food products
- Acquire skills in processing and preservation of perishable and non perishable foods
- Analyse methods used to identify, control and destroy microorganisms commonly found in food
- Understand the role of beneficial microorganisms in food processing and preservation
- Create biodegradable and edible food packaging materials
- Develop instant and innovative food products

Text Book(s):

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.

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19412.1	3	-	-	-	-	3	-	-	3	-	-	3	2	3	3
BT19412.2	3	-	-	-	-	-	1	-	3	-	-	3	-	3	3
BT19412.3	3	3	-	-	-	3	1	-	3	-	-	3	-	3	3
BT19412.4	3	-	-	-	-	-	-	-	3	-	-	3	-	3	3
BT19412.5	3	-	3	3	2	-	-	-	3	-	2	3	-	3	3
Average	3	0.6	0.6	0.6	0.4	1.2	0.4	-	3	-	0.4	3	0.4	3	3

GE19421 **SOFT SKILLS-I** **Category** **L T P C**
EEC **0 0 2 1**

Program Learning Goals:

This program will help our students to build confidence and improve their English communication in order to face the corporate world as well as providing them with opportunities to grow within an organisation.

Objectives:

- To help students break out of shyness.
- To build confidence
- To enhance English communication skills.
- To encourage students' creative thinking to help them frame their own opinions

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.

11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Outcomes: Upon completion of the course, the students will be

- Be more confident
- Speak in front of a large audience
- Be better creative thinkers
- Be spontaneous
- Know the importance of communicating in English.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19421.1	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
BT19421.2	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
BT19421.3	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
BT19421.4	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
BT19421.5	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
Average	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3

BT19501 BIOPROCESS PRINCIPLES

Category	L	T	P	C
PC	3	0	0	3

Objectives:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites
- To provide knowledge about media preparation and optimization.
- To learn about the types of sterilization and its kinetics.
- To endow the students with the basics of metabolic stoichiometry and energetics.
- To study about chemostat and microbial kinetics

UNIT-I OVERVIEW OF FERMENTATION PROCESSES 6

History 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 6

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 STERILIZATIONKINETICS 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 STOICHIOMETRYAND 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.

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 Contact Hours : 45

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.
- Apply the knowledge of media for new processes to make bio- products in economically feasible way.
- Interpret the sterilization kinetics and types of sterilization during fermentation processes.
- Enhance and modify the biological materials to improve its usefulness by finding the optimal formulation materials to facilitate product production.
- Design and work on chemostat and its kinetics

Text Book(s):

1 Shuler, Michael L. and Fikret Kargi, ― Bioprocess Engineering ―, Prentice Hall,1992.

2 Doran, Pauline ‒of Bioprocess Engineering Principles‒. Elsevier, 1995

Reference Books(s) / Web links:

1 Lydersen, BjornK.―Bioprocess Engineering Systems,Equipmentand Facilities‖JohnWiley,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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19501.1	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3
BT19501.2	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3
BT19501.3	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3
BT19501.4	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3
BT19501.5	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3
Average	3	3	2	3	3	-	-	-	2	2	2	3	-	2	3

BT 19502 **MOLECULAR BIOLOGY** **Category L T P C**

PC 3 0 0 3

Objectives:

- Familiarize students with cell and molecular components and their characteristics of both Prokaryotes and Eukaryotes.
- To elucidate the mechanisms of replication
- To provide in depth knowledge in transcription process
- To explain about the decoding process
- To provide in-depth knowledge in the area of gene expression and their regulation.

UNIT-I NUCLEIC ACIDS AND THEIR PROPERTIES 9

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of DNA and RNA, differences in DNA and RNA. Primary structure of DNA and RNA ,Chargaffs rule, Hogsteen base pairing, Denaturation and renaturation ,hyperchromic effect, Organization of genes in prokaryotic and eukaryotic chromosomes

UNIT-II DNA REPLICATION AND REPAIR 9

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, phage replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutation, various types of repair mechanisms.

UNIT-III TRANSCRIPTION 9

Transcription, characteristics of promoter and enhancer sequences. Inhibitors of transcription, ribozymes, post transcriptional modification, splicing, reverse transcription, transcriptomics.

UNIT-IV TRANSLATION 9

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. Protein localization

UNIT-V REGULATION OF GENE EXPRESSION 9

Prokaryotic gene regulation –lac and trp operon, gene transfer, Regulatable promoter transduction, transformation, Epigenetics

Total Contact Hours : 45

Course Outcomes: Students should be able to

- Describe the basic structure and biochemistry of nuclear components
- Demonstrate the replication mechanism
- Explain how synthesis of RNA occurs in the cell
- Describe the mechanism of protein synthesis and localization
- Understand gene expression.

Text Book(s):

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

Reference Books(s) / Web links:

1. Tropp, BurtonE. ―Molecular Biology: Genesto Proteins‖. IIIrd Edition.Jones and Bartlett, 2008.
2. Glick, B.R. andJ.J. Pasternak. ―Molecular Biotechnology : Principles and Applications of Recombinant DNA‖ 4th Edition. ASM,201

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19502.1	-	1	2	1	-	-	-	3	-	-	-	1	1	2	1
BT19502.2	-	2	3	-	3	-	-	3	-	2	2	3	2	3	2
BT19502.3	2	1	3	-	3	-	1	3	-	2	2	3	2	3	2
BT19502.4	-	1	3	2	3	-	-	3	-	2	2	3	2	3	2
BT19502.5	-	1	3	3	-	2	-	3	3	-	-	3	2	2	2
Average	0.4	1.2	2.8	1.2	1.8	0.4	0.2	3.0	0.6	1.2	1.2	2.6	1.8	2.6	1.8

BT19503 SEPARATION PROCESS PRINCIPLES

Category	L	T	P	C
ES	3	1	0	3

Objectives:

- To impart basic knowledge on mass transfer operations and diffusion in solids, Liquids & gases
- To gain knowledge on basic principles of gas absorption
- To pass on knowledge on basic principles and different types of distillation processes
- To comprehend on basic principles of L-L equilibrium and solid-liquid equilibrium
- To study the basic principles of solid-fluid associated mass transfer operations

UNIT-I DIFFUSION AND MASS TRANSFER 9

Molecular diffusion in fluids and solids; Inter phase Mass Transfer; Mass Transfer coefficients;

UNIT-II GAS LIQUID OPERATIONS 9

Principles of gas absorption; single component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts.

UNIT-III VAPOUR LIQUID OPERATIONS 9

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

UNIT-IV EXTRACTION OPERATIONS 9

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching-Principles.

UNIT-V SOLID FLUID OPERATIONS 9

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

Total Contact Hours : 45

Course Outcomes: Upon completion of this course the students will be able to

- Classify and use the accurate engineering correlations of diffusion and mass transfer coefficients.
- Investigate a multi-stage equilibrium separation processes and mass balances in continuous separation processes (absorbers, strippers) and sizing continuous separation units.
- Demonstrate about vapour- liquid equilibrium.
- Lay bare the concept of L-L and S-L equilibrium.
- Design and carryout the construction with operating principles of separating equipments

Text Book(s):

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 Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19503.1	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3
BT19503.2	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3
BT19503.3	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3
BT19503.4	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3
BT19503.5	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3
Average	3	3	3	3	3	-	-	-	2	2	1	2	-	2	3

BT19504 **IMMUNOLOGY** **Category L T P C**

PC 3 0 0 3

Objectives:

- To discuss the structure, functions and integration of immune cell networks
- To describe the features of T cell and B cell role in the immune system
- To familiarize the students about the immune diagnostic techniques
- To provide depth knowledge about the role of immune system against pathogens
- To explore the significance of immuno prophylaxis

UNIT-I ORGANIZATION OF IMMUNE SYSTEM 9

Hematopoiesis, immune cell network and their functions. Lymphoid organs- primary secondary and tertiary. Immunity- innate and acquired. Immune response – Humoral and cell mediated. Role of MHC in immune response. Antigens and its characterization, Adjutants.

UNIT-II LYMPHOCYTE BIOLOGY AND ANTIGEN ANTIBODY REACTION 9

Development, maturation, activation, differentiation and classification of T-cells and B-cells, antigen processing and presentation- Structure and function of immunolglobins . Immunoprecipitation- immune diffusion (ODD, SRID and Rocket immune electrophoresis), agglutination reaction – Blood grouping, comb and Widal reaction. ELISA, Immuno Histochemistry , Complement fixation test and cell sorting technique.

UNIT-III INFLAMATION AND HYPERSENSITIVITY 9

Inflammation, complement protein and its activation pathway. Allergy and Hypersensitivity – IgE mediated, Antibody dependent cytotoxicity, and immune complex mediated and delayed type hypersensitivity. Diagnosis of allergic reaction and its therapeutic modules.

UNIT-IV IMMUNE RESPONSE AND TUMOR IMMUNOLOGY 9

Protective immune responses against virus, bacteria, fungi and parasitic infections. Immuno deficiencies- Primary and secondary, tumor antigens, mechanism of tumor immune response and tumor immunotherapy. Autoimmunity- disorders and their therapy

UNIT-V TRANSPLANTATION AND APPLIED IMMUNOLOGY 9

Transplantation -HLA typing and graft rejection mechanism, Vaccine and types, immunization schedule. Production of Monoclonal and polyclonal antibodies, antibodies engineering and immuno modulatory drugs

Total Contact Hours : 45

Course Outcomes:

- Students will have a sound knowledge about the immune system and their role in disease protection
- Students will have profound knowledge in immuno diagnostic techniques.
- Students able to describe immune adverse reaction and their therapeutic approach
- Students will able to explain the features of immune response against antigens.
- Students familiar with transplantation and vaccine biology.

Text Book(s):

1 Roitt I, Male, Brostoff. Immunology, Mosby Publ., XIIth edition 2011.52

2 Kuby J, Immunology, WH Freeman & Co., 7th Edition2012.

3 Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006.

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19504.1	3	3	2	2	2	3	2	1	1	1	3	3	3	3	3
BT19504.2	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
BT19504.3	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
BT19504.4	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
BT19504.5	3	3	3	2	2	3	2	1	1	1	3	3	3	3	3
Average	3	3	3	1	2	3	2	1	1	1	3	3	3	3	3

BT19511 BIOPROCESS LABORATORY I

Category	L	T	P	C
PC	0	0	3	1.5

Objectives:

- To educate the students on the effect of various parameters on enzyme activity
- To impart the knowledge on enzyme inhibition kinetics
- To apply the concept of various enzyme immobilization techniques
- To study the growth kinetic of bacteria and fungi
- To prepare the suitable media for the growth of microorganisms.

List of 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
6 Enzyme immobilization – Crosslinking
7 Enzymatic conversion in Packed bed Column/Fluidized bed Column
8 Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
9 Growth of yeast – Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
10 Medium optimization – Plackett Burman Design

Total Contact Hours : 60

Course Outcomes: Upon completion of this course the students will be able to

- Determine the parameters involved in enzyme kinetic
- Carryout kinetics of enzyme inhibition
- Perform different types of enzyme immobilisation
- Evaluate the various parameters involved in growth kinetics
- Formulate the optimum media for the growth of microorganisms

Web links for virtual lab (if any)

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19511.1	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3
BT19511.2	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3
BT19511.3	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3
BT19511.4	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3
BT19511.5	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3
Average	3	3	3	3	3	1	-	1	2	2	1	2	-	2	3

BT19512 IMMUNOLOGY LABORATORY

Category	L	T	P	C
PC	0	0	3	1.5

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 immuno diagnosis.
- To train the students to handle the experiment animals for immunological research
- To provide basic skills in isolation and characterization of immune cells
- To familiarize the students to handle the laboratory animals for immunology experiments

List of Experiments

1 Handling of animals for immunological research
2 Preparation of antigen and raising of antisera.
3 Identification immune cells from blood smear.
4 Identification of blood group.
5 Preparation of serum and plasma from blood
6 Purification of immunoglobulin from serum.
7 Immunodiffusion.
8 Immuno electrophoresis.
9 Testing for typhoid antigens by Widal test
10 Enzyme Linked Immuno Sorbent Assay (ELISA)
11 Isolation of peripheral blood mononuclear cells
12 Pregnancy test(HCG)
13 Identification of t cells by T-cell rossetting using sheep RBC.

Total Contact Hours : 60

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
- Acquired e ability to rise antiserum against protein antigens by using experimental animals
- Students familiarize with immuno diagnostic techniques
- Students able to isolate and characterize the lymphocytes.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19512.1	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3
BT19512.2	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3
BT19512.3	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3
BT19512.4	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3
BT19512.5	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3
Average	3	3	3	3	3	3	2	2	3	1	3	3	3	3	3

GE19521 **SOFT SKILLS-II** **Category** **L T P C**
EEC **0 0 2 1**

Course Objectives:

- To help students break out of shyness.
- To build confidence
- To enhance English communication skills.
- To encourage students' creative thinking to help them frame their own opinions

Week	Activity Name	Description	Objective
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out-of-the - box thinking to ensure a good debate and defense skills.
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.

4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room “Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree”. The topics are then given to the class and students move to the corner that they feel best explains their opinions	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.
5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd.	The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills.
7	Debate	Does violence on the TV and Video games influence children negatively?	This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on.
8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	The aim of this activity is to make the participants become spontaneous and have good presence of mind.
9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	FictionAD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Outcomes: The students will be able to

- Be more confident
- Speak in front of a large audience without hesitation
- Think creatively
- Speak impromptu
- Communicate in English

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE19521.1	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
GE19521.2	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
GE19521.3	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
GE19521.4	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
GE19521.5	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3
Average	-	-	-	-	1	-	-	-	2	3	1	3	-	-	3

BT 19601 **BIOPROCESS TECHNOLOGY** **Category** **L T P C**

PC **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
- To impart knowledge about the immobilized reactors
- To learn about the various structured models
- To gain knowledge about recombinant cell cultivation

UNIT-I BIOREACTORS AND ITS MODE OF OPERATIONS 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 reactor.

UNIT-II MASS TRANSFER IN BIOREACTORS AND 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 OPERATIONAL CONSIDERATIONS IN IMMOBILIZED 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 STRATEGIES 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 Contact Hours : 45

Course Outcomes: The students will be able to

- Design 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 Book(s):

1 Shuler, Michael Land Fikret Kargi,—BioprocessEngineering—,PrenticeHall,1992.
2 Doran M Pauline –Bioprocess Engineering Principles‖. 2 nd Edition, Elsevier, 2012.
3 Ghasem D.Najafpour, —Biochemical Engineering and Biotechnology‖, Elsevier,2007.

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19601.1	3	2	2	2	2	1	1	-	2	-	-	3	-	3	3
BT19601.2	3	2	2	2	1	1	-	-	2	-	1	2	-	-	3
BT19601.3	3	2	2	2	1	-	1	-	2	-	1	3	-	2	3
BT19601.4	1	1	2	1	1	-	2	-	-	-	1	2	-	-	3
BT19601.5	-	1	2	2	2	2	1	-	2	-	2	3	-	3	3
Average	2	1.6	2	1.8	1.4	0.8	1	-	1.6	-	1	2.6	-	1.6	3

BT19602 GENETIC ENGINEERING

Category	L	T	P	C
PC	3	0	0	3

Objectives:

- To discuss the gene cloning methods, the tools and techniques involved in gene cloning and genome analysis.
- To explain the advanced gene isolation techniques
- To explain the applications of PCR
- To familiarize the students to carry out research in the determination of the gene and it's function
- To provide in-depth knowledge about functional genomics

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, Introduction of recombinant DNA in to host cells and selection methods.

UNIT-II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Screening methods for recombinant clones from DNA libraries using nucleic acid hybridization and Immunological and PCR Method. BACs and YACs, Chromosome walking

UNIT-III DNA SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger Coulson's and automated methods of DNA sequencing, pyrosequencing method. Principle of PCR,Types of PCR-Inverse PCR, Nested PCR, AFLP-PCR, Assembly PCR, Touch down PCR, Colony

PCR, Real-time PCR – SYBR green assay and Taqman assay; Site directed mutagenesis.

UNIT-IV MAPPING AND SEQUENCING OF GENOME 9

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

UNIT-V FUNCTIONAL GENOMICSS 9

Introduction to functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, MALDI-TOF, Yeast Two hybrid System.

Total Contact Hours : 45

Course Outcomes: The students will be able to

- Be aware of how to clone commercially important genes
- Produce the commercially important recombinant proteins
- Gain knowledge about genome sequencing methods
- Gain knowledge about how to characterize a gene
- Learn about DNA amplification and diagnosis of disease

Text Book(s):

1. Primrose SB and R. Twyman ―Principles Of Gene Manipulation &Geneomic Blackwell 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

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19602.1	-	3	-	3	-	-	3	3	3	-	2	3	3	3	3
BT19602.2	-	3	-	3	-	-	3	3	3	-	2	3	3	3	2
BT19602.3	-	3	-	2		-	3	3	3	-	2	3	3	3	3
BT19602.4	-	3	-	3	-	-	3	3	3	-	2	3	3	3	2
BT19602.5	-	3	-	2	-	-	3	3	3	-	2	3	3	3	2
Average	-	3	-	2.6	-	-	3	3	3	-	2	3	3	3	2.8

BT19603	CHEMICAL REACTION ENGINEERING	Category	L	T	P	C
		ES	3	0	0	3

Objectives:

- To impart knowledge about the different types of chemical reactions and development of kinetic models
- To develop design equation for different types of reactors
- To study the RTD in various reactors and parameters for design of reactors.
- To impart knowledge on design of heterogenous catalytic reactions
- To comprehend the design of heterogenous reactors for fluid-fluid and fluid-particle reactions.

UNIT-I KINETICS OF HOMOGENEOUS REACTIONS AND INTERPRETATION OF BATCH REACTOR DATA 9

Overview of chemical reaction Engineering, rate equations, concentration and temperature dependence, Constant and variable volume batch reactor.

UNIT-II IDEAL REACTORS 9

Ideal batch reactor, steady state mixed flow reactor and plug flow reactor, Size comparison of single reactors, multiple reactor systems.

UNIT-III NON IDEAL FLOW 9

Basics of Non - ideal flow, Dispersion model and Tank - in - series model.

UNIT-IV REACTIONS CATALYSED BY SOLIDS 9

Introduction to heterogeneous reactions, Pore diffusion resistance combined with surface kinetics, Performance equation for reactors with porous particles, Packed bed catalytic reactor and fluidized bed reactor of various types, Gas - Liquid reactions on solid catalyst: Trickle bed, slurry reactors and three phase-fluidized bed reactors.

UNIT-V NON – CATALYTIC SYSTEMS 9

Fluid-fluid reactions and reactors, Fluid - particle reactions: kinetics, Shrinking core model and Progressive conversion model, Fluid – Particle reactor design.

Total Contact Hours : 45

Course Outcomes: Upon completion of this course, students will be able to

- Identify, analyze and develop kinetic models for different types of homogeneous reactions
- Develop model equation and design reactors for homogeneous reactions.
- Apply RTD for various reactors and design real reactor
- Design reactors for heterogenous catalytic reactions
- Design reactors for fluid – fluid – particle reactions

Text Book(s):

1 Levenspiel O. Chemical Reaction Engineering. 3rd Edition. JohnWiley.1999.
2 Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice HallIndia.2002

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19603.1	3	3	3	2	-	-	-	-	2	-	3	3	2	-	2
BT19603.2	3	3	3	3	-	-	-	-	3	-	3	3	3	-	3
BT19603.3	3	3	3	3	-	-	-	-	3	-	3	3	3	-	3
BT19603.4	3	3	3	3	-	-	3	-	3	-	3	3	3	-	3
BT19603.5	3	3	3	3	-	-	3	-	3	-	3	3	3	-	3
Average	3	3	3	2.8	-	-	3	-	2.8	-	3	3	2.8	-	2.8

BT19604 INNOVATION AND DESIGN THINKING FOR BIOTECHNOLOGISTS

Category	L	T	P	C
EEC	0	0	4	2

Course objectives:
This course will enable the students to

- Be aware of innovative design and new product development
- Comprehend the importance of innovation and design thinking
- Apply innovative design in product development
- Familiarize the principles of biotechnology in product development
- Design and implement projects for the benefit of the society

UNIT-I INTRODUCTION TO DESIGN THINKING AND INNOVATION 6

Importance of innovation and design thinking in daily life -Types of innovation in design. Skills required for designing innovative products for end users. Need for innovative design thinking in entrepreneurship development programs of public and private agencies-MSME, BIRAC, Start up, Make in India (State and university innovation centres)- Copyright possibilities of practical application in industries. (Collect and collate the information and apply the same for practical applications).

UNIT-II STEPS IN SUCCESSFUL INNOVATION 6

Historical development of innovations in biotechnology (For example: from fermentation to gene editing) in medicine, agriculture, pharma, energy production milestones in biotechnology. Steps in successful scientific innovation (idea generation and mobilisation). Advocacy and screening, experimentation and commercialisation, diffusion and implementation.

UNIT-III STRATEGIES FOR DESIGN THINKING AND INNOVATION 6

Systematic approach to product development empathize design thinking as a systematic approach to innovation, brain storming ,visual thinking, design challenges, art of innovation, strategic for idea generation, creativity terms for innovation, solution finding methods, conventional, intuitive, discursive, methods for combining solution. Decision making for new design.

UNIT-IV DESIGN THINKING AND INNOVATION IN MODERN BIOTECHNOLOGY 6

Need for innovation in the field of medicine, environmental protection, agriculture, pharma, food etc. For example: innovations in cancer research and treatment, food processing and packaging, rDNA technology, gene editing, AI etc.(Discussion on any one innovation in biotechnology covering all the steps that led to innovation)

UNIT-V PRODUCT DEVELOPMENT 6

Design and develop an innovative process, method or product in any field of biotechnology based on societal and scientific needs.

Total Contact Hours : 30

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

- Understand the role of government and private agencies in innovative product development.
- Identify the needs for new product development in biotechnology.
- Approach product development in a systematic manner.
- Critically analyse the research problems and find a solution.
- Design and develop simple innovative methods and products

Text/Reference books:

- Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, "Exploring Engineering: An Introduction to Engineering and Design", 4th edition, Elsevier, 2016.
- David Ralzman, "History of Modern Design", 2nd edition, Laurence King Publishing Ltd., 2010.
- An AVA Book, "Design Thinking", AVA Publishing, 2010.
- Jeanne Liedtka and Tim Ogilvie Designing for Growth: A Design Thinking Tool Kit for Managers (Columbia University Press, 2011).
- Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, The Designing for Growth Field Book: A Step-by-Step Project Guide (Columbia University Press, 2014).

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19604.1	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3
BT19604.2	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3
BT19604.3	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3
BT19604.4	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3
BT19604.5	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3
Average	1	3	3	2	2	1	1	1	1	2	2	2	2	3	3

BT19611 **BIOPROCESS LABORATORY II** **Category** **L T P C**
PC **0 0 4 2**

Objectives: To enable the students to

- Apply the earlier learned knowledge about mass transfer kinetics and sterilization kinetics.
- Train the students to acquire the skills and knowledge in solving problems by analogy typical for the biotechnology industry
- Design and conduct experiments in bioreactors for the production of commercial products
- Enhance the students to design various bioreactor systems for the growth of microorganisms for its application in industries
- Inculcate creativity and innovation in the field of bioprocess engineering for the development of products useful to the society

List of Experiments

1. Batch Sterilization kinetics
2. Batch sterilization design
3. Thermal death kinetics

4 Estimation of K_La – Dynamic Gassing-out method
5 Estimation of K_La – Sulphite Oxidation Method
6 Estimation of K_La – Power Correlation Method
7 Fed batch cultivation and Total cell retention cultivation (bacteria & Yeast)
8 Algal cultivation-Photobioreactor
9 Residence time distribution
10 Estimation of Overall Heat Transfer Coefficient
11 Estimation of Mixing Time in reactor

Total Contact Hours : 60

Course Outcomes:

Upon completion of this course the students will be able to

- Gain ability to investigate, design and conduct experiments on batch sterilization kinetics
- Analyze and interpret data, and apply the laboratory skills to solve complex bioprocess engineering problems related to fed batch cultivation of microbes
- Demonstrate advancement in their skills in operating instruments like Photobioreactor, exhaust gas analyser
- Estimate and quantify the distribution and utilization of nutrients by Residence Time Distribution studies
- Perform competently in chemical and bioprocess industries and become important contributors for solving problems about mass transfer and heat transfer kinetics in bio reactors

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
BT19611/1	1	1	2	2	-	-	-	-	-	-	-	-	1	2	3
BT19611/2	1	1	2	2	-	-	-	-	-	-	-	-	1	2	3
BT19611/3	-	2	2	-	2	-	-	-	-	-	-	3	1	2	3
BT19611/4	-	2	2	-	2	-	-	-	-	-	-	3	1	2	3
BT19611/5	-	2	2	-	2	-	-	-	-	-	2	3	2	3	3
Average	0.4	1.6	2	0.8	1.2	-	-	-	-	-	0.4	1.8	1	2.2	3

BT19612 MOLECULAR BIOLOGY AND GENETIC ENGINEERING LABORATORY

Category	L	T	P	C
PC	0	0	4	2

Objectives:

- To provide hands on practical training in the isolation of genomic DNA from different sources.
- To discuss the principles behind the recombinant DNA technology.
- To explain the concept of transformation.
- To provide in depth knowledge in protein characterization techniques.

- To develop the skills of the students by providing hands on practical training in Molecular biology

List of Experiments

1. Agarose gel electrophoresis
2. Isolation of genomic DNA from bacteria.
3. Isolation of genomic DNA from animal tissue.
4. Isolation of genomic DNA from plant.
5. Isolation of plasmid DNA from bacteria.
6. Check the purity of DNA by using UVspectrophotometer.
7. PCR
8. Elution of DNA from agarose gel.
9. Restriction enzyme digestion.
10. Ligation
11. Competent cells preparation ,transformation and blue white screening method
12. SDS-PAGE.
13. Western blotting.

Total Contact Hours : 60

Course Outcomes: Upon completion of this course the students will be able to

- Produce transgenic animals and plants
- Analyze nucleic acid molecules quantitatively
- Clone and express a gene and produce therapeutically valuable proteins.
- Modify the enzyme activity and improve its half- life by using site directed mutagenesis.
- Perform protein expression and characterization

Reference Books(s) / Web links:

1. Sambrook, Josephand David W. Russell ‐The Condensed Protocols: From Molecular Cloning: A Laboratory Manual‖ Cold Spring Harbor,2006
2. Old RW, Primrose SB, ―Principles Of Gene Manipulation, An Introduction To Genetic Engineering ‐, Blackwell Science Publications,1993.
3. AnsubelFM, Brent R, Kingston RE, Moore DD, ‐Current Protocols In Molecular Biology ―,Greene Publishing Associates, NY,1988.
4. Berger Sl, Kimmer AR, ―Methods In Enzymology‖, Vol 152, Academic Press,1987.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19612.1	-	3	3	3	-	-	3	3	3	-	2	3	3	3	2
BT19612.2	-	3	3	3	-	-	3	3	3	-	2	3	3	3	2
BT19612.3	-	3	3	3		-	3	3	3	-	2	3	3	2	2
BT19612.4	-	3	3	3	-	-	3	3	3	-	2	3	3	3	2
BT19612.5	-	3	3	3	-	-	3	3	3	-	2	3	3	2	2
Average	-	3	3	3	-	-	3	3	3	-	2	3	3	2.6	2

BT19613	NUMERICAL PROGRAMMMING FOR BIOTECHNOLOGISTS	Category	L	T	P	C
		PC	0	0	2	1

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 Piechart.

Total Contact Hours : 30

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(s):

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.

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19613.1	3	3	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19613.2	2	2	3	2	3	-	-	-	3	3	2	3	1	2	3
BT19613.3	2	2	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19613.4	2	2	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19613.5	2	2	3	3	2	-	-	-	3	3	2	2	1	2	3
Average	2.2	2.2	3	2.2	2.2	-	-	-	3	3	2	2.8	1	2	3

BT19701	DOWNSTREAM PROCESSING	Category	L	T	P	C
		PC	3	1	0	3

Objectives:

- To have depth idea about downstream processing, pretreatment and stabilization of bio-products.
- To know the basic principles of filtration and centrifugation.
- To know the fundamental idea about Extraction and membrane separation techniques and will learn how to develop models for precipitation technique.
- To work on chromatographic techniques and able to do Scaling up of chromatography.
- To know the fundamental concept and operational principles of crystallization , drying and lyophilization and to do research

UNIT-I DOWNSTREAM PROCESSING 9

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 9

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

UNIT-III ISOLATIONOFPRODUCTS 9

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 9

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 9

Crystallization, drying and lyophilization in final product formulation.

Total Contact Hours : 45

Course Outcomes: Upon completion of this course the students will

- Have in depth idea about downstream processing, pre-treatment and stabilization of bio-products.
- Know the basic principles of filtration and centrifugation.
- Be able to know the fundamental idea about extraction and membrane separation techniques and will learn how to develop models for precipitation technique.
- Work on chromatographic techniques for different applications
- Know the fundamental concept and operational principles of crystallization , drying and lyophilization and to do research

Text Book(s):

- Belter,P.A.,E.L.CusslerandWei-Houhu―Bioseparations–DownstreamProcessingforBiotechnology‖, John Wiley,1988.
- Sivasankar, B. ―Bioseparations : Principles and Techniques‖. PHI,2005.
- Asenjo,JuanA.―SeparationProcessesinBiotechnology‖.CRC/Taylor&Francis,1990.

Reference Books(s) / Web links:

- Ghosh, Raja –Principles of Bioseparations Engineering‖. World Scientific, 2006
- ―Product Recovery in Bioprocess Technology‖. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier,2004.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19701.1	2	-	2	-	-	3	1	-	2	-	-	-	-	1	2
BT19701.2	3	3	2	2	-	-	-	-	-	-	-	1	-	1	2
BT19701.3	3	2	2	1	1	-	-	-	-	-	1	1	1	1	2
BT19701.4	3	3	3	2	2	-	-	-	1	-	-	-	1	1	2
BT19701.5	3	2	3	3	2	-	-	-	1	-	-	-	-	1	2
Average	2.8	2	2.4	1.6	1	0.6	0.2	-	0.8	-	0.2	0.4	0.4	1	2

BT19702 **BIOINFORMATICS** **Category** **L T P C**

PC **3 0 0 3**

Objectives: To enable the students

- To introduce biological databases and their utility
- To understand need for various sequence alignment tools
- To study phylogenetic relationships and modelling protein structures
- To apply machine learning skills in biotechnology problem solving
- To become conversant in R programming

UNIT-I INTRODUCTION 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 SEQUENCE ALIGNMENT 9

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms.

UNIT-III PHYLOGENY AND PROTEIN STRUCTURE PREDICTION 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 MACHINE LEARNING AND APPLICATION OF BIOINFORMATICS 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 R PROGRAMMING 9

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

Total Contact Hours : 45

Course Outcomes: Upon completion of this course the 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 Book(s):

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. R Programming for Bioinformatics by Robert Gentleman, 1st Edition, CRC Press, Taylor and Francis Group

Reference Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19702.1	3	3	3	2	3	1	-	-	-	-	1	2	2	2	3
BT19702.2	3	3	3	3	3	1	-	-	-	-	-	2	2	2	3
BT19702.3	3	3	3	3	3	1	-	-	-	-	-	3	2	2	3
BT19702.4	3	3	3	2	3	1	-	-	-	-	-	3	2	3	3
BT19702.5	3	3	3	3	2	-	-	-	-	-	-	3	1	2	2
Average	3	3	3	2.6	2.8	0.8	-	-	-	-	0.2	2.6	1.8	2.2	2.8

BT19703 PROTEIN ENGINEERING

Category	L	T	P	C
PC	4	0	0	4

Objectives: To enable the students

- To gain a strong knowledge about the amino acids, bonds and protein structure.
- To educate about the protein architecture, super secondary structure.
- To learn the ways to predict the structure using various structure prediction tools.
- To know the basic structure and function relationship of proteins.
- To learn the proteomics techniques

UNIT-I BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS 6

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).

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 8

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

UNIT-IV STRUCTURE-FUNCTION RELATIONSHIP 9

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers, Membrane proteins: General characteristics, Trans-membrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase.

UNIT-V PROTEOMICS 12

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 Contact Hours : 45

Text Book(s):

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.

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19703.1	2	1	1	2	1	1	-	-	-	-	-	1	1	1	2
BT19703.2	1	2	1	2	1	-	-	-	-	-	-	1	1	1	2
BT19703.3	1	2	1	2	2	-	-	-	-	-	-	2	2	1	2
BT19703.4	1	1	1	2	2	-	-	-	-	-	-	2	2	1	2
BT19703.5	1	1	1	3	2	2	-	-	-	-	-	2	1	1	2
Average	1.2	1.4	1	2.2	1.6	1.5	-	-	-	-	-	1.6	1.4	1	2

BT19711	DOWNSTREAM PROCESSING LABORATORY	Category	L	T	P	C
		PC	0	0	3	1.5

AIM

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

Objectives:

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

List of Experiments

1. Solid liquid separation – centrifugation, microfiltration/ Ultrafiltration
2. Batch sedimentation
3. Cell disruption techniques – Ultra sonication, French press
4. Precipitation – Ammonium Sulphate precipitation, Isoelectric method
5. Aqueous two phase extraction
6. HPLC
7. High resolution purification – Affinity chromatography.
8. High resolution purification – Ion exchange chromatography.
9. Product polishing – Gel filtration chromatography, Dialysis
10. Product polishing – Freeze drying

Total Contact Hours : 60

Course Outcomes:

- Students will able to 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 able to use the techniques like 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 earn broad education in formulating the product which is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Reference Books(s) / Web links:

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.K. Scopes – Protein Purification – Principles And Practice, Narosa Pub. (1994).
3. Sivasankar, B. “Bioseparations : Principles and Techniques”. PHI, 2005.
4. Ghosh, R., “Principles of Bioseparations Engineering”, World Scientific Publishers, 2006.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19711.1	3	3	2	-	3	2	3	-	2	-	3	3	2	3	3
BT19711.2	2	-	-	2	-	--	-	-	2	-	3	3	3	3	2
BT19711.3	2	-	-	1	3	-	-	-	2	-	3	3	3	3	3
BT19711.4	2	-	-	2	2	-	-	-	2	-	3	3	2	3	1
BT19711.5	2	-	-	2	3	-	3	-	2	-	3	3	3	3	2
Average	2.2	0.6	0.4	1.4	2.2	0.4	1.2	-	2	-	3	3	2.6	3	2.2

BT19712 **BIOINFORMATICS LABORATORY** **Category** **L T P C**

PC **0 0 3 1.5**

Objectives: To enable the students

- To be conversant in UNIX commands
- To be able to use biological databases
- To understand evolutionary relationship between sequences
- To be aware of online resources for genomic information
- To study protein interaction pathway

List of Experiments

1 Basic UNIX commands

2 Types of Biological Databases and Using it:
Genbank
Protein Data Bank
Uniprot
Pfam
CATH

3 Sequence Analysis Tools:
Use of BLAST, FASTA (Nucleic Acids & Protiens).
Use of Clustal W.
Use of EMBOSS.

4 Phylogenetic Analysis
Use of PHYLIP.

5 Molecular Modeling.
Homology Modeling – Swiss modeller.

6 UCSC Genome Browser Protein Pathway Analysis

7 Protein Pathway Analysis

8 Programming Languages: R for biological data analysis

Total Contact Hours : 30

Course Outcomes: Upon completion of this course the students will be able to

- Use basic commands in UNIX OS to work with various bioinformatics software.
- Retrieve information from different biological databases.
- Carry out sequence and phylogenetic analysis.
- Use genome browsers
- Understand the role of protein interaction in normal and diseased conditions

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19712.1	3	3	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19712.2	2	2	3	2	3	-	-	-	3	3	2	3	1	2	3
BT19712.3	2	2	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19712.4	2	2	3	2	2	-	-	-	3	3	2	3	1	2	3
BT19712.5	2	2	3	3	2	-	-	-	3	3	2	2	1	2	3
Average	2.2	2.2	3	2.2	2.2	-	-	-	3	3	2	2.8	1	2	3

BT19713 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR BIOTECHNOLOGIST

Category	L	T	P	C
PC	0	0	4	2

Course objectives: To enable the students

- To gain knowledge about the biological data and curation process required for specific application
- To learn different software packages used for Machine Learning
- To develop Machine Learning code for specific applications

List of domain areas

Protein structure function
Drug discovery/drug target identification/drug delivery/toxicity prediction
Biomarker discovery and diagnostics
Image processing based diagnostics
Cancer data analysis/early diagnosis
Electronic health record, disease progression report generation, clinical trial data analysis
Medication management
Gene editing/discovery
Anti-biofilm target
ML methods in designing electronic counterparts of biological sensory systems

Course outcomes: Upon completion of the course, the student will be able to

- Analyze/apply the suitability of the available data for the development/curation of data
- Apply different software packages for Machine Learning
- Develop Machine Learning code for specific purpose

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
BT19713. 1	3	3	2	3	3	2	-	-	3	3	3	3	3	3	3
BT19713. 2	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3
BT19713. 3	3	3	3	3	3	2	-	-	3	3	3	3	3	3	3
Average	3	3	2.67	3	3	2	-	-	3	3	3	3	3	3	3

		Category	L	T	P	C
CR19621	**MICROFLUIDICS LABORATORY**	**PE**	**0**	**0**	**2**	**1**

Objectives:

- To introduce and strengthen the concept of microfluidic technology
- To gain clear understanding of fabrication techniques in microfluidics
- To familiarize the ways to analyse various applications of microfluidics
- To impart knowledge on the CAD design of micro-mixers
- To empower the students to design and fabricate novel microfluidic devices

1	Microfluidic Technology - Introduction, definitions and applications
2	Materials for microfluidic device fabrication
3	Fabrication Techniques for Microfluidics, Soft Lithography Technique in detail
4	Laboratory session 1- wafer cleaning process
5	Laboratory session 2- Prime mould fabrication
6	Laboratory session 3- Replicas by casting
7	Laboratory session 4- Sealing of microchannel with a cover glass
8	Laboratory session 5- Leak testing
9	Laboratory session 6- Characterization of microchannels
10	CAD design of microchannels, Simulation of micro-mixers
11	Applications of microfluidics – recent reports

Total contact hours : 30

Course Outcomes:

On completion of the course, students will be able to

- understand the fundamentals of microfluidic technology.
- demonstrate the various fabrication techniques used in microfluidics.
- analyse the working and design of various microfluidic devices.
- design complex micro-mixers using CAD software.
- fabricate any microfluidic devices in real time

References:

1. Albert Folch, “Introduction to BioMEMS”, CRC press, Taylor and Francis group, 2013.
2. Yujun Song, Daojian Cheng, Liang Zhao, “Microfluidics: Fundamentals, Devices, and Applications”, Wiley VCH publications, 2018.

3 Patrick Tabeling, Suelin Chen," Introduction to Microfluidics", Oxford University press,first edition 2005, reprint 2011.

4 Suman Chakraborty, Microfluidics and Microfabrication, Springer, 2014, ISBN-10:9781489984609

PROFESSIONAL ELECTIVES

BT19P51	BIOPHARMACEUTICAL TECHNOLOGY	Category	L	T	P	C
		PE	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 provide in depth knowledge in the preparation of different types of drug formulations.
- To discuss the preparation and mechanism of drug delivery of the advanced drug delivery systems
- To explain the physicochemical properties, pharmacology of commonly used biopharmaceuticals.

UNIT-I INTRODUCTION 9

Pharmaceutical industry and development of drugs-preclinical trials, clinical trials and regulatory aspects-FDA and CDSCO; Types of therapeutic agents and their uses

UNIT-II 9

DRUG ACTION AND PHARMACOKINETICS

Route of drug administration, pharmacodynamics, pharmacokinetics – Absorption, Distribution, Metabolism and Excretion of drugs / metabolites, Prodrugs – drug targeting, significance of 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 RELEASE MEDICATIONS 9

Design of oral controlled drug delivery systems- dissolution controlled release system, Diffusion controlled release system and oral osmotic pump. Parenteral controlled drug delivery – liposomes. Osmotic pump (Implants). Transdermal drug delivery systems.

UNIT-V BIOPHARMACEUTICALS 9

Various categories of therapeutics like Laxatives, NSAID, Contraceptives, Antibiotics- penicillin, Broad spectrum antibiotics, Aminoglycoside antibiotics and Macrolide antibiotics, Insulin, Toxoids – Diphtheria and Tetanus.

Total Contact Hours : 45

Course Outcomes: Upon completion of the course, the graduates will be able to

- Students will be able to develop a new drug with therapeutic value
- Students will know the basic principles of pharmacodynamics and pharmacokinetics
- Students will be able to prepare different types of formulations of drugs such as tablets, capsules, syrups etc.
- Students will be able to develop an advanced drug delivery systems.
- Students will be able to comprehend the pharmacodynamic and pharmacokinetics properties of different types of therapeutic agents

Text Book(s):

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.

Reference Books(s) / Web links:

1 Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2 Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3 Reminton .The Science and Practice of Pharmacy, 21st edition

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P51.1	1	-	2	3	3	3	3	3	3	3	3	3	3	3	3
BT19P51.2	2	2	2	2	3	3	-	3	3	3	3	2	3	2	3
BT19P51.3	-	3	3	2	-	3	3	3	2	-	-	-	2	3	-
BT19P51.4	-	-	3	2	3	3	-	3	3	-	-	-	3	3	-
BT19P51.5	-	2	2	1	-	3	-	3	3	-	-	-	3	2	1
Average	0.6	1.4	2.4	2.0	1.8	3.0	1.2	3.0	2.8	1.2	1.2	1.0	2.8	2.6	1.4

BT19P52 **CLINICAL BIOCHEMISTRY** **Category** **L** **T** **P** **C**
PE **3** **0** **0** **3**

Objectives:

- To provide information about clinical changes in disorders of metabolic pathways
- To disseminate knowledge about hormone related disorders
- To analyse lifestyle diseases and their prevention
- 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 - Type I, clinical features, metabolic changes. Glycosuria, galactosemia and fructosuria.

UNIT-II 9

HORMONAL DISORDERS

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

UNIT-III LIFE STYLE DISEASES AND PREVENTATION 9

Stress -Type II Diabetes, Obesity, Artherosclerosis, Heart diseases, Hypertension, Ageing, ulcer. Cancer, Pulmonary disease, Cirrhosis, Nephritis (Renal stones, Glomerular, acute and chronic).

UNIT-IV 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-V BIOTECHNOLOGY 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 Contact Hours : 45

Course Outcomes: Upon completion of the course, the graduates will be able to

- comprehend the abnormalities associated with metabolic pathways
- ascertain the importance of hormones and associated 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 Book(s):

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

Reference Books(s) / Web links:

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.

4 Alan H. Gowenlock, Varley's Practical Clinical Biochemistry, Sixth Edition- CBS Publisher

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P52.1	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3
BT19P52.2	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3
BT19P52.3	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3
BT19P52.4	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3
BT19P52.5	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3
Average	3	3	3	3	2	3	2	2	3	2	2	3	3	3	3

BT19P53 FUNDAMENTALS OF NANOTECHNOLOGY

Category	L	T	P	C
PE	3	0	0	3

Objectives:

- To learn about basis of nanomaterial science, preparation method, types and application.
- To acquire an understanding the preparation methods
- To understand in broad outline of Nanomaterials – structure, properties and applications
- To develop knowledge about the different characterization techniques
- To understand in broad outline of Applications of Nanotechnology in various fields

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 9

GENERAL METHODS OF PREPARATION

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, AgTiO2 , 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 sun barrier products - In Photostat, printing, solar cell, battery

Total Contact Hours : 45

Course Outcomes: Upon completion of the course, the graduates will be able to

- Students will gain knowledge on essential role of nanoscience.
- Students will be able to understand the preparation methods of nanomaterials
- Students will be able to get ideas on various nanomaterials and its properties, structure and applications
- Students will be able to comprehend the different characterization techniques
- Students will be able to understand and improved the application of nanotechnology

Text Book(s):

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

Reference Books(s) / Web links:

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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P53.1	2	2	2	2	3	3	1	1	2	-	1	3	1	2	3
BT19P53.2	2	2	2	2	3	3	1	1	2	-	1	2	1	2	3
BT19P53.3	2	2	2	2	3	3	1	1	2	-	2	3	2	2	3

BT19P53.4	2	2	2	2	3	3	1	1	2	--	2	3	2	2	3
BT19P53.5	2	2	2	2	3	3	1	1	2	-	2	3	2	2	3
Average	2	2	2	2	3	3	1	1	2	-	1.6	2.8	1.6	2	3

BT19P54 **BIOSAFETY AND HAZARD MANAGEMENT** **Category** **L T P C**

PE 3 0 0 3

Objectives:

- To empahzise the need and safety in industries
- To grasp the safety procedure and implementation process
- To comprehend the various types of risk
- To identify the types of hazards and its analysis
- To conduct Hazop studies.

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 – rapid and 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 Fix borough-Mexico-Madras-Vizag Bopal analysis.

UNIT-V 9

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

Total Contact Hours : 45

Course Outcomes: Upon the completion of the course, Students will be able to

- Identify the safety needs of industries
- Apply the principles and implementation of safety procedures
- Assess and analyse the various types of risk
- Analyse various Hazard analysis models
- Practice Hazop studies in industries

Text Book(s):

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,bDyadem Press, 2004.

Reference Books(s) / Web links:

1 Handley,W.,—IndustrialSafetyHandBook—,2ndEdn.,McGraw-HillBookCompany,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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P54.1	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3
BT19P54.2	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3
BT19P54.3	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3
BT19P54.4	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3
BT19P54.5	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3
Average	1	3	2	1	1	2	2	1	2	-	2	3	-	-	3

BT19P61 **MARINE BIOTECHNOLOGY** **Category** **L T P C**

PE **3 0 0 3**

Objectives: To enable the students

- 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 – aqua farm design and construction.

Total Contact Hours : 45

Course Outcomes:

On completion of the course, the students will be to

- Learn about different marine ecosystems
- Identify the flora and fauna of marine environment
- Aware of the ways and means to protect the environment from various types of pollution.
- Comprehend the importance of marine organisms and produce new marine products
- Design aquaculture farm with new technology

Text /Reference 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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P61 .1	3	3	-	1	-	2	3	2	-	2	3	3	3	3	3
BT19P61 .2	3	3	-	2	-	2	3	2	-	2	3	3	3	3	3
BT19P61 .3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT19P61 .4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
BT19P61 .5	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
Average	3	3	3	2.4	3	2.6	3	2.6	3	2.4	3	3	3	3	3

BT19P62 MEDICAL MICROBIOLOGY

Category	L	T	P	C
PE	3	0	0	3

Objectives: To enable the students

- To understand the host parasite relationship in microbial disease
- To impart knowledge on the pathogenesis of medical bacteriology
- To acquire knowledge on the replication of viruses in diseases
- To learn the medical importance of Mycology & Parasitology
- To develop skills for the diagnosis of diseases with modern tools

UNIT-I BASICS IN MEDICAL MICROBIOLOGY 9

Basics in Medical microbiology - Infectious diseases overview. Infection: Sources, portals of entry and transmission, Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases, Immunity of microbial diseases.

UNIT-II BACTERIOLOGY 9

Morphology, pathogenesis, diagnosis, treatment, prevention and control of diseases caused by Staphylococci, Streptococci, Bacillus, Clostridium, Corynebacterium, Escherichia, Salmonella, Shigella, Klebsiella, Proteus, Vibrio, Pseudomonas, Mycobacteria, Spirochaetes and Rickettsia.

UNIT-III VIROLOGY 9

Structure, multiplication, pathogenesis, diagnosis, treatment, prevention and control of diseases caused by of DNA viruses - Pox, Herpes, Hepatitis, Adeno; RNA viruses - Picorna, Orthomyxo, Paramyxo, Rabdo and HIV virus.

UNIT-IV MYCOLOGY & PARASITOLOGY 9

General characteristics, pathogenesis, diagnosis, treatment, prevention and control of human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida, opportunistic mycoses. Mycotoxins. Medically important Parasitic disease caused by Entamoeba, Giardia, Plasmodium, Taenia, Ascaris, Wucherhiria.

UNIT-V LABORATORY MANAGEMENT AND DIAGNOSIS OF MICROBIAL DISEASES 9

Diagnosis of disease: Collection, transportation and preliminary processing of clinical specimens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases, Prevention and control of microbial infections.

Total Contact Hours : 45

Outcomes: On completion of this course, the students will be able to

- Gain knowledge about the host parasite relationship in microbial disease
- Be aware on the pathogenesis of medical bacteriology
- Acquire knowledge on the replication of viruses in diseases
- Apply the medical importance of Mycology & Parasitology
- Develop skills for the diagnosis of diseases with modern tools

Reference Books(s) / Web links:

1. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.
2. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.
3. Ananthanarayan and Paniker's Text book of Microbiology (1978) Universities Press (9th edition), Hyderabad.
4. David Greenwood, Richard CD, Slack, John Forrest Peutherer. (1992) Medical Microbiology. 14th edition. ELBS with Churchill Livingstone.
5. Hugo WB and Russell AD. (1989) Pharmaceutical Microbiology IV edition. Blackwell Scientific Publication, Oxford.
6. Joan Stokes E, Ridgway GL and Wren MWD. (1993). Clinical Microbiology, 7th edition. Edward Arnold. A division of Hodder and Stoughton.
7. Ronald M. Atlas. (1989) Microbiology. Fundamentals and Applications. II edition, Maxwell Macmillan international editions.
8. Topley & Wilsons's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III Bacterial Diseases, Edward Arnold, London.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P62.1	3	2	2	3	1	3	2	1	3	2	2	3	3	1	2
BT19P62.2	2	1	1	1	1	3	0	0	2	2	1	3	3	2	1
BT19P62.3	2	1	1	1	1	3	0	0	2	2	1	3	3	2	1
BT19P62.4	2	1	1	1	1	3	0	0	2	2	1	3	3	2	1
BT19P62.5	3	2	3	3	3	3	2	1	3	2	2	3	3	3	3
AVERAGE	2.4	1.4	1.6	1.8	1.4	3	0.8	0.4	2.4	2	1.4	3	3	2	1.6

GE19304 FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS Category L T P C

PE 3 0 0 3

Objectives:

- To expose the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.

UNIT-I I INTODUCTION TO MANAGMENT 9

Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of management thought. Organization: Types and environmental factors.

UNIT-II PLANNING AND DECISION MAKING 9

General Framework for Planning – Planning Process, Types of Plans, Management by Objectives; Decision making and Problem Solving - Steps in Problem Solving and Decision Making.

UNIT-III ORGANIZATION AND hRM 9

Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization. Human Resource Management & Business Strategy: Talent Management and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT-IV LEADING AND MOTIVATION 9

Leadership, Power and Authority, Leadership Styles, Leadership Skills, Leader as Mentor and Coach, Team Leadership. Motivation – Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories – Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT-V CONTROLLING 9

Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems. Managing productivity- Cost control- Purchase control- Maintenance control- Quality control- Planning operations. Managing globally- Strategies for International business.

Total Contact Hours : 45

Course Outcomes:

- Understand and apply the basic principles of management.
- Understand and apply the planning, organizing and control processes,

- Will be able to understand and design organization as well as manage and develop human resource.
- Understand various theories related to the development of leadership skills, motivation techniques and team work
- Will be able to understand and apply controlling practices in all applications.

Text Book (s):

1 Principles of Management, Prakash Chandra Tripathi, Tata McGraw-Hill Education, 2008
2 Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

Reference Books(s) / Web links:

1 Essentials of Management, Koontz Kleihrich, Tata Mc – Graw Hill.
2 Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P63.1	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-
BT19P63.2	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-
BT19P63.3	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-
BT19P63.4	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-
BT19P63.5	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-
Average	1	-	-	-	-	-	-	1	2	-	2	2	-	2	-

BT19P64 PLANT BIOTECHNOLOGY

Category	L	T	P	C
PE	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 OFGENETIC MATERIAL 9

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of prokaryotic and eukaryotic transcription and translation, regulation of gene expression in eukaryotes.

UNIT-II CHLOROPLASTAND 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 to mitochondria and chloroplast.

UNIT-III NITROGEN FIXATION 9

Nitrogenase enzyme components and activity, nod genes and nif genes regulation, bacteroids, nodulation, genetic complementation.

UNIT-IV AGROBACTERIUM AND 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, Secondary metabolites: production of flavonoids etc., using plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming, therapeutic products like hirudin and plantibodies, commercial products like bioplastics and polyfructans.

Total Contact Hours : 45

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

- Describe in-depth knowledge about the fundamentals of plant cell, functions and genome organisation.
- Comprehend about chloroplast and mitochondrial functions and organization which will aid in the insertion of new genes to create transgenic plants.
- Illustrate strong understanding of the nitrogen fixing mechanism and genetic engineering of nif and nod genes to improve crop growth.
- Apply the knowledge of viral vectors and techniques of plant biotechnology.
- Evaluate various techniques in plant tissue culture for raising transgenic plants and development of therapeutic products.

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 ―PlantBiotechnology‖,OxfordUniversityPress,USA,2003.

Reference Books :

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P64.1	-	3	-	3	-	-	3	3	3	-	2	3	3	3	3
BT19P64.2	-	3	-	3	-	-	3	3	3	-	2	3	3	3	2
BT19P64.3	-	3	-	2		-	3	3	3	-	2	3	3	3	3
BT19P64.4	-	3	-	3	-	-	3	3	3	-	2	3	3	3	2
BT19P64.5	-	3	-	2	-	-	3	3	3	-	2	3	3	3	2
Average	-	3	-	2.6	-	-	3	3	3	-	2	3	3	3	2.8

BT19P65 BIOINDUSTRIAL ENTREPRENEURSHIP AND IPR

Category	L	T	P	C
PE	3	0	0	3

Objectives:

- To enable the students to realise the importance of becoming an entrepreneur
- To develop a business plan
- To gain knowledge on various aspects of establishing a business
- To have an idea on financial management
- To inculcate the business ethics

UNIT-I INTRODUCTION TO ENTREPRENEURSHIP 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 STEPS TO DEVELOP A BUSINESS PLAN 9

Develop a Business Plan

UNIT-III MARKETING AND STAFF MANAGEMENT 9

Choose Your Location and Set Up for Business- Market Your Business - Hire and Manage a Staff

UNIT-IV FINANCE AND ACCOUNTING 9

Finance, Protect and Insure Your Business - Record Keeping and Accounting - Financial Management

UNIT-V LEGAL AND ETHICAL CONCERNS 9

Meet Your Legal, Ethical, Social Obligations - Growth in Today‘s Marketplace

Total Contact Hours : 45

Course Outcomes: Upon completion of this course, students will be able to:

- Acquire relevant knowledge on Entrepreneurs Need and Market Need
- Learn key strategies for a business plan
- Perform how to set up a business, advertise and hire and manage a staff
- Develop confidence in financial management
- Get ideas on Legal, Ethical, Social Obligation

Text Book(s):

1 Entrepreneurship Ideas in Action – South Western, 2000

Reference Books(s) / Web links:

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 Delhi1997.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P65.1	1	1	1	2	1	2	-	-	1	2	2	2	-	-	2
BT19P65.2	1	1	1	2	1	2	-	-	1	2	2	2	-	-	2
BT19P65.3	1	1	1	2	1	2	-	-	1	2	2	2	-	-	2
BT19P65.4	1	1	1	2	1	2	-	-	1	2	2	2	-	-	3
BT19P65.5	1	1	1	2	1	2	-	-	1	2	2	2	-	-	3
AVERAGE	**1**	**1**	**1**	**2**	**1**	**2**	**-**	**-**	**1**	**2**	**2**	**2**	**-**	**-**	**2**

BT19P71	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

- Perform well in 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.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P71.1	2	2	2	1	1	2	1	-	1	-	-	2	1	2	3
BT19P71.2	2	2	2	1	1	2	1	-	1	-	-	2	1	2	3
BT19P71.3	2	2	2	2	2	2	1	-	1	-	2	2	1	2	3
BT19P71.4	2	2	2	2	2	2	1	-	1	-	2	2	1	2	3
BT19P71.5	2	2	2	2	2	2	1	-	1	-	2	2	1	2	3
Average	**2**	**2**	**2**	**1.6**	**1.6**	**2**	**1**	**-**	**1**	**-**	**2**	**2**	**1**	**2**	**3**

BT19P72 **MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES** **Category** **L T P C**

PE **3 0 0 3**

Objectives: The students will be able to

- Learn the key concepts of pathogenicity and their modes of entry
- Study the host defense against pathogens and pathogenic strategies
- Gain sound knowledge about the molecular mechanism of virulence
- Understand the host pathogen interactions and their control mechanism
- Learn the techniques of molecular approach to control the microbial pathogens

UNIT-I OVERVIEW AND BASICS OF MICROBIAL PATHOGENESIS 5

Historical perspective - discovery of microscope, Louis Pasteur‘s contributions, Robert Koch‘s postulates, early discoveries of microbial toxins, toxic assays, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types (bacteria, fungi, virus and parasites) and their modes of entry.

UNIT-II HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES 8

Attributes & components of microbial pathogenesis, Host defense mechanism by humoral and cellular, 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, Bacterial secretion system in Gram positive bacteria, *mycobacterium tuberculosis* – transmission and pathogenesis. Shigellosis, Candidiasis, Plasmodium: Life cycle and its mechanism. Influenza virus pathogenesis.

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 Contact Hours : 45

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

- Describe the basic feature of pathogenesis and how microorganisms are involved in disease progress.
- Understand the host defense strategy against pathogens and bacterial defense strategies.
- Gain knowledge about the molecular mechanism of virulence and the cause of bacterial infections.
- Apply the basic knowledge about the host pathogen interactions.
- Investigate different molecular techniques to control the mechanism of microbial pathogens.

Text Book(s):

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

Reference Books

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., EMBOetc
3. Nester, Anderson, Roberts, Pearsall, Nester, ―Microbiology: A Human Perspective‖, Mc Graw Hill, 3rd Edition, 2001.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P72.1	1	3	3	3	1	2	1	-	-	2	1	3	3	2	1
BT19P72.2	1	3	3	3	1	2	1	1	2	2	1	3	3	2	2
BT19P72.3	1	3	3	3	-	2	1	-	2	2	1	3	3	3	3
BT19P72.4	1	3	3	3	1	2	1	-	2	2	1	3	3	3	3
BT19P72.5	1	3	3	3	1	2	2	1	2	2	2	3	3	3	3
Average	1	3	3	3	0.8	2	1.2	0.2	1.6	2	1.2	3	3	2.6	2.4

BT17P73 **CLINICAL PROTEOMICS** **Category** **L T P C**
PE **3 0 0 3**

Objectives: To enable the students

- Understand the origin and need for proteomics studies
- Learn various gel based proteomics and staining techniques
- Learn use of isotopes in gel free proteomics techniques
- Learn latest technologies in protein interactions
- Apply the techniques for diagnostics in clinical samples

UNIT-I INTRODUCTION TO PROTEOMICS 7

Overview of protein structure, localization and compartmentalization; Relationship between protein structure and function; Protein-protein interactions and identification; proteome and proteomics; Types of Proteomics- Structural proteomics, Functional proteomics; Extraction and separation of Proteins from Biological Samples, protein quantification techniques. Tandem Mass Spectrometry and MALDI-TOF for Protein Identification, Peptide fragmentation, Peptide mass fingerprinting database searching. fragmentation patterns and data analysis, MS for PTM analysis.

UNIT-II GEL-BASED PROTEOMICS 12

Two dimensional gel electrophoresis (2-DE); Staining procedures to visualize 2-D gels; Difference In-Gel Electrophoresis for Quantitation of Protein Expression; Tools for analysis of gels; Gel-based Proteomic Data Analysis; 2-D Fluorescence Difference Gel Electrophoresis (DIGE); 2D-DIGE Clinical Applications; Blue native PAGE (BN-PAGE); Modifications in gel-electrophoresis technique; Molecular scanner; Application of 2-DE and DIGE techniques in biological systems; Merits and demerits of gel-based proteomic techniques.

UNIT-III GEL-FREE PROTEOMICS 7

In vivo Quantitative Proteomics using SILAC, SILAC Clinical Applications; Isotope Coded Affinity Tagging (ICAT); *In vitro* Quantitative Proteomics using iTRAQ; iTRAQ Clinical Applications; Proteolytic labelling with [^{18}O]-water; Merits and demerits of gel-free quantitative proteomic techniques.

UNIT-IV INTERACTOMICS AND LABEL FREE PROTEOMICS 12

Techniques to Study Protein Protein Interactions, Antigen and Antibody Microarrays, Reversed Phase Protein Microarrays, Cell free Expression Based Protein Microarrays, Nucleic Acid Programmable Protein Arrays, Microarrays for Autoantibody Profiling, Microarrays for PTM Analysis. Label free Proteomics, Surface Plasmon Resonance, Surface Plasmon Resonance Imaging, Protein Interaction Analysis using SPR and SPRi, Nanotechnologies in Proteomics.

UNIT-V CLINICAL APPLICATIONS OF PROTEOMICS ANALYSIS 7

Challenges in Clinical Proteomics, Serum Proteomics, Urine Proteomics, Salivary Proteomics, Bioinformatics and Proteomics, Proteomics for Translational Research, Future of Proteomic Technologies for Clinical Applications.

Total Contact Hours : 45

Course Outcomes: Upon completion of this course the students will be able to

- Understand the role of mass spectrometry in protein identification
- Analyze various gel based techniques available to study protein expression
- Apply various gel-free based techniques available to study protein expression
- Investigate possible protein-protein interaction using wide range of methods
- Comprehend physiological conditions based on proteomic analysis of clinical isolates

Text Book(s):

1 Introduction to Proteomics: Tools for the New Biology, 2nd Edition by Daniel C. Liebler, Humana Press, 2007
2 Principles of Proteomics, 2nd Edition by Richard Twyman, Garland Science, 2013
3 Introduction to Proteomics: Principles and applications by Nawin Mishra, Wiley & Sons, 2010
4 Biomedical Applications of Proteomics by Garry L. Corthals (Editor), Denis F. Hochstrasser (Editor), Jean-Charles Sanchez (Editor) Publisher:Wiley ISBN:9783527308071
5 Proteomics: A Cold Spring Harbor Laboratory Course Manual, A.J. Link and J. LaBaer, Cold Spring Harbor Laboratory Press, 2009.

Reference Books(s) / Web links:

1 Introducing Proteomics: From Concepts to Sample Separation, Mass Spectrometry and Data Analysis, Josip Lovric, Publisher:Wiley, ISBN:9780470035245
2 Proteomics in Practice: A Guide to Successful Experimental Design, 2nd Edition by Reiner Westermeier, Tom Naven, Publisher: Wiley.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P73.1	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3
BT19P73.2	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3
BT19P73.3	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3
BT19P73.4	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3
BT19P73.5	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3
Average	3	3	3	3	3	3	-	-	2	-	3	3	3	3	3

BT19P74 CANCER BIOLOGY

Category	L	T	P	C
PE	3	0	0	3

Objectives: To enable the students

- To predict the regulation of cell cycle and its role in cancer.
- To categorize the mechanism of chemical, physical and virus induced carcinogenesis.
- To comprehend the molecular mechanism of cancer formation, signal transduction pathways and their relation to cancer.
- To explore the concepts of molecular mechanism of cancer metastasis.
- To evaluate the current modes of cancer treatment and diagnosis, useful for scientific research.

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, signaling pathways – growth factors, G proteins, Wnt, JAK-STAT, TGF-β, PI3K/AKT, intrinsic and extrinsic apoptotic pathways.

UNIT-II PRINCIPLES OF CARCINOGENESIS 12

Carcinogenesis – classification and metabolism of chemical carcinogens mechanism of chemical carcinogenesis, identification of carcinogens, radiations and cancer – UV, ionising radiations – X-ray, nuclear, microwave etc,

DNA damage due to chemicals & radiations and DNA repair mechanisms, infectious agents and cancer – RNA, DNA virus, bacteria- *H. pylori*; parasites- blood fluke, liver fluke and carcinogenesis. Heredity and cancer.

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, CDKN2A, 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 prevention, screening and detection, tumor markers. Different forms of therapy - chemotherapy, surgery, radiation therapy, recent advances in cancer therapy – Stem cell, immuno, gene therapy and molecular targeting.

Total Contact Hours : 45

Course Outcomes: Upon completion of this course the students will be able

- To interpret the role of signal transduction pathways and cell cycle in cancer
- To analyse the risk factors and prevent cancer
- To study the molecular mechanism of oncogenes
- To evaluate cancer metastasis and angiogenesis
- To analyse and design chemo, radiation and advanced therapies for cancer

Text Book(s):

1 LewisJ Kleinsmith, ―Principlesof Cancer Biology‖Pearsonnew int. Edition, 2013.

Reference Books(s) / Web links:	
1	King, Roger J.B. ―Cancer Biology‖ Addison Wesley Longman,1996.
2	Ruddon, Raymond W. ―Cancer Biology‖IIIrd Edition. Oxford UniversityPress,1995.
3	Weinberg, R.A. ―The Biologyof Cancer‖Garland Science, 2007
4	McDonald, F etal., ― Molecular Biology of Cancer‖ IInd Edition. Taylor & Francis,2004.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P74.1	3	3	2	3	-	-	2	-	-	-	-	2	3	2	3
BT19P74.2	2	3	2	2	2	3	3	2	2	-	-	3	3	3	3
BT19P74.3	2	3	2	2	1	-	2	-	-	-	-	2	3	2	2
BT19P74.4	3	3	2	2	2	2	3	-	-	-	-	2	3	2	2
BT19P74.5	3	3	3	3	3	3	3	3	2	-	2	3	3	3	3
Average	2.6	3	2.2	2.4	1.6	1.6	2.6	1	0.8	0	0.4	2.4	3	2.4	2.6

BT19P75	BIOPHYSICS	Category	L	T	P	C
		PE	3	0	0	3

Course objectives:
This course will enable the students to

- Gain structural knowledge of biological systems.
- 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 Contact Hours : 45

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

- Understand the various forces responsible for biological molecular structure
- Analyze the different levels of conformation in biomolecules
- Gain knowledge of cellular permeability and ion transport
- Apply the dynamics of biological systems

Text books:

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

Reference books:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P75.1	3	2	2	3	2	-	-	-	-	-	-	2	2	1	3
BT19P75.2	3	2	2	3	2	-	-	-	-	-	-	2	2	1	3
BT19P75.3	3	2	2	3	2	-	-	-	-	-	-	2	2	1	3
BT19P75.4	3	2	2	3	2	-	-	-	-	-	-	2	2	1	3
BT19P75.5	3	3	2	3	2	-	-	-	-	-	-	2	2	1	3
Average	3	2.2	2	3	2	-	-	-	-	-		2	2	1	3

BT19P76 ANIMAL BIOTECHNOLOGY

Category	L	T	P	C
PE	3	0	0	3

Objectives:

- To enrich the knowledge about animal tissue and cell cultures
- To provide the details of animal diseases and diagnostic techniques
- To know the functions of recombinant cytokines, monoclonal antibodies, and vaccines for the treatment of animal diseases
- To offer knowledge about various modern breeding techniques for the production of farm animals
- To apply the process of transgenesis for the production of transgenic animals

UNIT-I ANIMAL CELL CULTURE 11

Basic tissue culture techniques – Animal cell culture media – General composition, classification, and examples – 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, and suspension cultures. Cell cultures as a source of valuable products.

UNIT-II ANIMAL DISEASES AND THEIR DIAGNOSIS 10

Bacterial and viral diseases in animals – Production of monoclonal antibodies and their use in diagnosis – Molecular diagnostic techniques – PCR, in-situ hybridization, Northern and Southern blotting, and RFLP.

UNIT-III ANIMAL DISEASES AND THERAPEUTICS 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 equipment 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 6

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 Contact Hours : 45

Course Outcomes: Upon completion of this course, the student would

- Understand about animal tissue and cell cultures
- Analyze and interpret bacterial and viral diseases in animals through various diagnostic techniques
- Plan and choose the therapy for animal infections
- Utilize modern breeding techniques for the production of farm animals
- Apply the process of trangenesis for the development of transgenic animals

Text Book(s):

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 Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P76.1	3	3	3	3	3	3	-	-	-	3	-	3	3	2	3
BT19P76.2	3	3	3	3	3	2	-	-	2	3	-	3	3	2	3
BT19P76.3	3	3	3	3	3	3	-	-	2	3	-	3	3	3	3
BT19P76.4	3	3	3	3	3	2	-	3	3	3	-	3	3	3	3
BT19P76.5	3	3	3	3	3	3	-	3	3	3	-	3	3	3	3
Average	**3**	**3**	**3**	**3**	**3**	**2.6**	**-**	**3**	**2.5**	**3**	**-**	**3**	**3**	**2.6**	**3**

BT19P77 STEM CELL AND REGENERATIVE MEDICINE

Category	L	T	P	C
PE	3	0	0	3

Course objectives:
This course will enable the students

- To understand the fundamentals of stem cell technology.
- To study the types of stem cells and their regulations.
- To learn about cancer stem cells.
- To know the details of haemopoietic stem cells and their regulation.
- To identify the ethical concerns, and applications of stem cell in clinical research.

UNIT-I STEM CELLS AND CELLULAR PEDIGREES **9**

Stem cells evolution- History perspective of stem cells, Scope of stem cells- definition of stem cells, concepts of stem cells- differentiation, maturation, proliferation, potency and plasticity, self-maintenance and self-renewal – Stem cells markers, Stem cells niches, Trans differentiation. Obstacles for stem cell maintenance - preservation protocols.

UNIT-II STEM CELLS TYPES AND REGULATION **9**

Adult stem cells in animals, skeletal muscle stem cells - Mammary stem cells- Intestinal Stem cells-Keratinocyte stem cells of cornea-skin and hair follicles - Embryonic stem cell biology- Characterization of Embryonic stem cells, Extracellular signalling involved in Embryonic Vs Adult stem cells, factors influencing proliferation and differentiation of stem cells - hormonal role in differentiation. Cancer stem cells and its types.

UNIT-III HEMATOPOIETIC STEM CELLS AND THEIR DIFFERENTIATION **9**

Hematopoietic stem cells mobilization, mesenchymal stem cells and their properties, Hematopoietic Vs mesenchymal stem cells. Isolation of hematopoietic and mesenchymal stem cells, Ex vivo expansion, Characterization of Hematopoietic and mesenchymal stem cells. Growth factors for hematopoietic stem cells. Transcriptional regulation of hematopoietic and mesenchymal stem cells, hematopoietic differentiating pathway.

UNIT-V STEM CELLS AND REGENRATIVE MEDICINE **9**

Stem cells in Genetic disease. Role of stem cells in hemolytic anemia. Cellular therapies- stem cells therapy for degenerative neuronal diseases, stem cells therapy in spinal cord regeneration and muscular dystrophies. Immunotherapy - tissue engineering - blood and bone marrow. Stem cells for corneal repair.

UNIT V ETHICAL ISSUES AND REGULATIONS **9**

Ethical issues in stem cell technology, stem cell regulations, debate, social and ethical concerns associated with it. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

Total Contact Hours : 45

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

- Gain knowledge about the key principles of stem cell technology.
- Acquire an idea about the types of stem cells and their regulations.
- Understand and gain knowledge about cancer stem cells.
- Gain knowledge about the haemopoietic stem cells and their regulation.
- Understand the ethical concerns and apply stem cell research in regenerative medicine.

Text books:

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

Reference books:

- Clive Svendensen and Allison D. Ebert, Encyclopedia of stem cell research, volume 1.
- Stem cell basics and application" Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
- Berger A.C. Beachy S.H and Olson S .Stem Cells Therapies, National Academic press, Washington DC, USA 2014.
- Daniel R. Marshak, ―Stem cell biology‖ cold spring laboratory press.
- Robert Lanza, –Essentials of stem cell biology‖ Elsevier, 2001
- Stem cell therapy for organ failures- Edited by S. Indumathi, Springer Verlag, 2015.

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P77.1	2	3	1	2	3	2	3	1	2	3	1	3	1	1	2
BT19P77.2	3	2	2	3	1	1	3	2	3	1	3	3	2	3	2
BT19P77.3	3	3	3	2	2	2	1	3	1	3	2	1	2	3	3
BT19P77.4	3	3	3	2	2	3	2	3	3	2	3	2	3	2	3
BT19P77.5	2	3	2	3	3	2	3	2	2	2	1	3	1	3	2
Average	2.6	2.8	2.2	2.4	2.2	2	2.4	2.2	2.2	2.2	2	2.4	1.8	2.4	2.4

BT19P78 NEUROBIOLOGY AND COGNITIVE SCIENCES **Category L T P C**
PE 3 0 0 3

Objectives: To enable the students

- Know the general organization of brain, neurons and glial cells
- Learn physiological aspects and coding of neurons

- Apply the mechanism of action of neurotransmitters and hormones
- Analyze the mechanism of five senses
- Illustrate behavioural aspects such as sleep feeding and motivation

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 and brain waves recorded on EEG, hearing and memory; Disorders associated with the nervous system like Alzheimers disease, Parkinsons disease, schizophrenia and depression.

Total Contact Hours : 45

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

- Comprehend the anatomy and organization of nervous systems
- Describe the function of nervous systems
- Analyze how drugs and hormones affect cellular function in the nervous system
- Apply the basic mechanisms of five senses
- Illustrate the mechanisms associated with behavioral science

Text Book(s):

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 Books(s) / Web links:

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P78.1	3	3	3	2	2	3	2	3	2	0	0	3	3	2	1
BT19P78.2	3	3	3	2	2	3	2	2	2	0	0	2	3	2	1
BT19P78.3	3	3	3	2	2	2	2	2	2	0	0	2	3	2	1
BT19P78.4	3	3	3	2	2	3	2	2	2	0	0	3	3	2	1
BT19P78.5	3	3	3	3	2	2	2	2	2	0	0	3	3	2	1
Average	3	3	3	2.2	2	2.6	2	2.2	2	0	0	2.6	3	2	1

BT19P79	BIOCONJUGATE TECHNOLOGY AND APPLICATIONS	Category	L	T	P	C
		PE	3	0	0	3

Objectives:

- To understand the derivatization processes of amino acids in proteins
- To demonstrate about the active functionalities and their derivatization
- To apply knowledge about bioconjugate reagents.
- To explain enzyme and nucleic acid modification and their conjugation
- To create strategies for the preparation of various conjugates and their applications

UNIT-I FUNCTIONALTARGETS 9

Amino acids - structure and nature. Derivatization of amino acids – Asp, Glu, Lys, Tyr and C and N terminal amino acids – Important functional groups of polypeptide – Protection of the native conformation and activity of proteins – Oxidative modifications of Pro, Arg, Lys, Tyr, Phe, Cys, & Met – Detection of protein oxidation.

UNIT-II CHEMISTRY OFACTIVEG ROUPS 9

Sugar functional groups – Derivatization of sugars, polysaccharides, and glycoconjugates - Amine, Thiol, and Photoreactive chemical reactions.

UNIT-III BIOCONJUGATE REAGENTS 9

Zero length cross-linkers – Definition, examples, and reactions of carbodiimides – Homo and Hetero bifunctional cross-linkers – Classification, structure, properties, and uses - Trifunctional cross-linkers – Definition, examples – Cleavable reagent systems.

UNIT-IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Characteristics of common enzymes used for conjugation – Preparation of activated enzymes for conjugation – Chemical modification of nucleic acids – Biotin labeling of DNA – Enzyme conjugation to DNA.

UNIT-V BIOCONJUGATE APPLICATIONS 9

Preparation of hapten-carrier immunogen conjugates – Antibody modification and conjugation – Immunotoxin conjugation techniques – Conjugation of protein to liposome – Preparation of different sizes of colloidal gold – Preparation of colloidal gold-labeled proteins and their applications.

Total Contact Hours : 45

Course Outcomes: Upon completion of this course, the student would

- Understand about functional targets for the derivatization of proteins, polypeptide, and amino acids
- Illustrate active functional groups and their derivatization process
- Demonstrate and apply bioconjugate reagents for the preparation bioconjugates
- Perform enzymes and nucleic acid modification and conjugation
- Create and apply strategies for the preparation of various bioconjugates.

Text Book(s):

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

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BT19P79.1	3	2	2	3	3	2	-	-	3	3	-	3	3	3	2
BT19P79.2	3	3	3	3	3	2	-	-	3	3	-	3	3	3	3
BT19P79.3	3	3	3	3	3	2	-	-	3	3	-	3	3	3	3
BT19P79.4	3	3	3	3	3	2	-	-	3	3	3	3	3	2	3
BT19P79.5	3	3	3	3	3	2	-	-	3	3	3	3	3	3	2
Average	3	2.8	2.8	3	3	2	-	-	3	3	3	3	3	2.8	2.6