P.S.R. ENGINEERING COLLEGE

(An Autonomous Institution & Affiliated to Anna University, Chennai)

SIVAKASI – 626 140

Curriculum and Syllabi

REGULATION - 2016

B.Tech., BIOTECHNOLOGY

(FULL TIME)

DEPARTMENT VISION & MISSION

Vision

- To produce graduates capable of effectively using the imparted scientific and technical knowledge to meet the dynamic demands of biotechnological industry with social values.

Mission

- Offering under graduate programme by providing effective and well balanced curriculum and equip themselves to gear up to the challenges awaiting them.
- Providing the technical, research and intellectual resources that will enable the students to have a successful career in the field of Biotechnology.
- Providing need based training and professional skills to satisfy the needs of society and the industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)

- Lead a professional career by acquiring the basic knowledge in the field of specialization and allied Engineering.
- Assess the real life problems and deal with them confidently relevance to the society.
- Engage in lifelong learning by pursuing higher studies and participating in professional organizations.
- Exhibit interpersonal skills and able to work as a team for success.

PROGRAMME SPECIFIC OUTCOMES (PSO’s)

1. Acquire competency in applications of engineering principles to biological systems.
2. Able to design and analyze varied biotechnological solutions for industrial applications.
3. Apply biochemical and microbial processing techniques for agriculture and medical applications.
4. Exhibit interpersonal knowledge to develop futuristic bioengineering solutions.

PROGRAMME OUTCOMES (PO's)

Engineering Graduates will be able to:

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 analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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 need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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 on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

P.S.R. ENGINEERING COLLEGE, SIVAKASI-626 140
UG REGUALTION-2016
B. TECH BIO-TECHNOLOGY
CURRICULUM AND SYLLABI
[I – VIII SEMESTER]

Total Credits: 176

SEMESTER – I

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161HS11	Essential English	HS	3-0-0	3
2	161MA11	Engineering Mathematics - I	BS	3-1-0	4
3	161PH11	Engineering Physics	BS	3-0-0	3
4	161CY11	Engineering Chemistry	BS	3-0-0	3
5	161CS11	Computer Programming	ES	3-0-0	3
6	161ME11	Engineering Graphics	ES	1-0-3	3
Practical					
7	161PC17	Physics and Chemistry Laboratory - I	BS	0-0-3	2
8	161CS17	Computer Practices Laboratory	ES	0-0-3	2
9	161EE17	Engineering Practices Laboratory	ES	0-0-3	2
				No. of Credits:	**25**

SEMESTER – II

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161HS21	Technical English	HS	3-0-0	3
2	161MA21	Engineering Mathematics - II	BS	3-1-0	4
3	161PH21	Physics of Materials	BS	3-0-0	3
4	161CH21	Environmental Science and Engineering	BS	3-0-0	3
5	161BT21	Biochemistry – I	ES	3-0-0	3
6	161BT22	Microbiology	PC	3-0-0	3
Practical					
7	161PC27	Physics and Chemistry Laboratory – II	BS	0-0-3	2
8	161BT27	Biochemistry Laboratory	ES	0-0-3	2
9	161BT28	Microbiology Laboratory	ES	0-0-3	2
				No. of Credits:	**25**

SEMESTER – III

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161MA31	Transforms and Partial Differential Equations	BS	3-2-0	4
2	161BT31	Stoichiometry and Fluid Mechanics	PC	4-0-0	4
3	161BT32	Cell Biology	PC	4-0-0	4
4	161BT33	Principles of Genetics	PC	3-0-0	3
5	161BT34	Enzyme Technology	PC	3-0-0	3
6	161BT35	Biochemistry–II	PC	4-0-0	4
Practical					
7	161BT37	Cell Biology Laboratory	PC	0-0-3	2
8	161BT38	Bio organic Chemistry Laboratory	PC	0-0-3	2
9	161HS39	Functional English – I	EEC	0-0-2	-
				No. of Credits:	**26**

SEMESTER – IV

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161MA42	Statistics and Numerical Methods	BS	3-0-0	3

2	161BT41	Molecular Biology	PC	3-0-0	3
3	161BT42	Unit Operations	PC	3-0-0	3
4	161BT43	Chemical Engineering Thermodynamics	PC	3-0-0	3
5	161BT44	Analytical Methods in Biotechnology	PC	3-0-0	3
6	161BT45	Basic Industrial Biotechnology	PC	3-0-0	3
Practical					
7	161BT47	Analytical Methods in Biotechnology Laboratory	PC	0-0-3	2
8	161BT48	Chemical Engineering Laboratory	PC	0-0-3	2
9	161HS49	Functional English – II	EEC	0-0-2	-
				No. of Credits:	**23**

SEMESTER – V

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161BT51	Bioprocess Principles	PC	3-0-0	3
2	161BT52	Bioinformatics	PC	3-0-0	3
3	161BT53	Mass Transfer operations	PC	3-0-0	3
4	161BT54	Plant Biotechnology	PC	3-0-0	3
5	161BT55	Protein Engineering	PC	3-0-0	3
6	161BT56	Bioethics	PC	3-0-0	3
Practical					
7	161BT57	Molecular Biology Laboratory	PC	0-0-3	2
8	161BT58	Bioinformatics Laboratory	PC	0-0-3	2
9	161HS59	Career English – I	EEC	0-0-2	-
				No. of Credits:	**22**

SEMESTER – VI

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161BT61	Chemical Reaction Engineering	PC	3-1-0	4
2	161BT62	Immunology	PC	3-0-0	3
3	161BT63	Genetic Engineering	PC	3-0-0	3
4	161HS61	Engineering economics and management	HS	3-0-0	3
5	E1	Elective –I	PE	3-0-0	3
6	E2	Elective –II	OE / PE	3-0-0	3
Practical					
7	161BT67	Genetic Engineering Laboratory	PC	0-0-3	2
8	161BT68	Immunology Laboratory	PC	0-0-3	2
9	161HS69	Career English – II	EEC	0-0-2	-
				No. of Credits:	**23**

SEMESTER – VII

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	161BT71	Bioprocess Engineering	PC	3-1-0	4
2	161BT72	Downstream processing	PC	3-0-0	3
3	161BT73	Genomics and Proteomics	PC	3-0-0	3
4	161BT74	Nano Biotechnology	PC	3-0-0	3
5	E3	Elective – III	PE	3-0-0	3
6	E4	Elective – IV	OE/PE	3-0-0	3
Practical					
7	161BT77	Bioprocess Laboratory	PC	0-0-3	2
8	161BT78	Downstream processing Laboratory	PC	0-0-3	2
				No. of Credits:	**22**

SEMESTER – VIII

Sl. No.	Code	Course Title	Category	L-T-P	C
Theory					
1	E5	Elective – V	PE	3-0-0	3
2	E6	Elective – VI	OE/PE	3-0-0	3
Practical					
3	161BT87	Project Work	EEC	0-0-12	6
				No. of Credits:	**12**

HS – Humanity Science,
BS – Basic Science,
ES – Engineering Science,
PC – Programme Core,
PE – Programme Elective,
OE – Open Elective,
EEC – Employment Enhancement Course

List of Electives

Programme Electives					
Sl. No.	**Course Code**	**Course Title**	**Category**	**L-T-P**	**Credit**
1	161BTE01	Biophysics	PE	3-0-0	3
2	161BTE02	Biological Spectroscopy	PE	3-0-0	3
3	161BTE03	Developmental Biology	PE	3-0-0	3
4	161BTE04	Biopharmaceutical Technology	PE	3-0-0	3
5	161BTE05	Principles of Food Processing	PE	3-0-0	3
6	161BTE06	Marine Biotechnology	PE	3-0-0	3
7	161BTE07	Animal Biotechnology	PE	3-0-0	3
8	161BTE08	Cancer Biology	PE	3-0-0	3
9	161BTE09	Bio conjugate Technology	PE	3-0-0	3
10	161BTE10	Stem Cell Technology	PE	3-0-0	3
11	161BTE11	Molecular Pathogenesis	PE	3-0-0	3
12	161BTE12	Molecular Modeling & Drug Design	PE	3-0-0	3
13	161BTE13	Metabolic Engineering	PE	3-0-0	3
14	161BTE14	Immunotechnology	PE	3-0-0	3
15	161BTE15	Neurobiology and Cognitive Sciences	PE	3-0-0	3
16	161BTE16	Process Instrumentation Dynamics and Control	PE	3-0-0	3

List of Open Electives Offered by Department of Bio Technology

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE501	Process Equipment and Plant Design	OE	3-0-0	3
2	161OE502	Biomaterials	OE	3-0-0	3
3	161OE503	Biosensors	OE	3-0-0	3
4	161OE504	Food Science and Technology	OE	3-0-0	3

List of Open Electives
Offered by Department of Computer Science and Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE101	Web development using PHP	OE	3-0-0	3
2	161OE102	Programming in PERL	OE	3-0-0	3
3	161OE103	Multimedia & Animation Tools	OE	3-0-0	3
4	161OE104	Multicore Architecture	OE	3-0-0	3
5	161OE105	Green Computing	OE	3-0-0	3
6	161OE106	Soft Computing	OE	3-0-0	3
7	161OE107	Java Scripts	OE	3-0-0	3

Offered by Department of Electronics and Communication Engineering

Sl. No.	Course Code	Name of the Course	Category	L-T-P	Credit
1	161OE201	Bio Medical Instrumentation	OE	3-0-0	3
2	161OE202	Digital Image Processing	OE	3-0-0	3
3	161OE203	Consumer Electronics	OE	3-0-0	3
4	161OE204	Multimedia Compression and Communication	OE	3-0-0	3
5	161OE205	High Speed Networks	OE	3-0-0	3

Offered by Department of Electrical and Electronics Engineering					
Sl. No.	**Course Code**	**Name of the Course**	**Category**	**L-T-P**	**Credit**
1	161OE401	Energy audit and conservation	OE	3-0-0	3
2	161OE402	Principles of Virtual Instrumentation	OE	3-0-0	3
3	161OE403	Sensors and Transducers	OE	3-0-0	3
4	161OE404	Aircraft electronic system	OE	3-0-0	3
5	161OE405	Electrical safety	OE	3-0-0	3
6	161OE406	Vehicle electric power Systems	OE	3-0-0	3
7	161OE407	Domestic and Industrial Electrical Installation	OE	3-0-0	3
Offered by Department of Mechanical Engineering					
Sl. No.	**Course Code**	**Name of the Course**	**Category**	**L-T-P**	**Credit**
1	161OE601	Maintenance Engineering	OE	3-0-0	3
2	161OE602	Non Destructive Testing and Materials	OE	3-0-0	3
3	161OE603	Operations Research	OE	3-0-0	3
4	161OE604	Renewable Sources of Energy	OE	3-0-0	3
5	161OE605	Robotics	OE	3-0-0	3
Offered by Department of Civil Engineering					
Sl. No.	**Course Code**	**Name of the Course**	**Category**	**L-T-P**	**Credit**
1	161OE701	Disaster Management System	OE	3-0-0	3
2	161OE702	Fundamentals of Fire Safety Engineering	OE	3-0-0	3
3	161OE703	Optimization in Engineering	OE	3-0-0	3
4	161OE704	Renewable Energy Sources	OE	3-0-0	3
5	161OE705	Environmental Impact and Risk Assessment	OE	3-0-0	3
6	161OE706	Environment and Ecology	OE	3-0-0	3
7	161OE707	Technology Management	OE	3-0-0	3
8	161OE708	Sustainable Management of Urban Ecology	OE	3-0-0	3
Offered by Department of Management Studies					
Sl. No.	**Course Code**	**Name of the Course**	**Category**	**L-T-P**	**Credit**
1	161OE801	Essentials of Management	OE	3-0-0	3
2	161OE802	Fundamentals of Marketing	OE	3-0-0	3
3	161OE803	Managing Human Resources	OE	3-0-0	3
4	161OE804	Professional Ethics in Engineering	OE	3-0-0	3

Additional Eligibility requirement for the award of degree

1. The co-curricular activities one or more of the following is/are compulsory for a student in the first three years of his/her study with satisfactory grade to eligible for the award of degree with a satisfactory grade is compulsory to be eligible for the award of degree in the first two years of study
    - National Service Scheme (NSS)
    - Youth Red Cross (YRC)
    - Red Ribbon Club (RRC)
    - Institute of Electrical Electronics Engineering (IEEE)
    - Indian Society for Technical Education (ISTE)
    - Society of Automotive Engineers (SAE)
    - Sports & Games
2. Every student should undergo In Plant Training/Internship/Industrial visit with due approval of HOD & Principal.

161HS11	ESSENTIAL ENGLISH	L-T-P	C
		3-0-0	3

Programme: B.E/B.TECH. Common to all Branches **Sem: 1** **Category: HS**

Prerequisites: Nil

AIM: To impart Basic English Language skill to develop the students ability to use English effectively

Course Outcomes:

The Students will be able to

CO1: Understand and use different forms of language.
CO2: Write formal letters.
CO3: Speak in English with clarity.
CO4: Listen actively and grasp the contents of the speech.
CO5: Read general texts and comprehend their content.
CO6: Use grammar to make meaning in both speaking and writing.
CO7 :Describe situations both in speaking and writing.

UNIT I **9**

Grammar - tense - past simple, present simple, verbal vs non-verbal communication, Vocabulary- Commonly used words - Spelling, Reading - Reading Newspapers, Writing - Formal Letters - Requisition for leave - Bonafide, Listening - Listening to famous speeches, Speaking - introducing oneself.

UNIT II **9**

Grammar – tense - past and present simple continuous, Vocabulary - Prefixes, Suffixes - Parts of Speech, Reading - Basic reading comprehension, Writing Formal Letters - Permission letters – In - plant training - Industrial visit, Listening - Listening to Interviews, Speaking - Speaking about interests, one's friends, hobbies, favourite programmes.

UNIT III **9**

Grammar – tense - past and present perfect, Vocabulary - Forms of Verb – Analogy – Sentences - Types, Reading - Cloze Test, Writing - Paragraph writing – descriptions - Comparing and contrasting - describing pictures, Listening - Listening to News, Speaking - Future plan - Native place, Appropriate body language.

UNIT IV **9**

Grammar - perfect tenses, Vocabulary – Single - line definitions – Pronoun – Adverbs - Preposition, Reading - Reading for comprehension, Writing - e-mail - basic conventions writing – Instructions - Recommendations, Listening - Listening to Debates, Speaking - Giving opinions.

UNIT V **9**

Grammar-subject - verb agreement, Vocabulary - commonly confused words - Linkers – Abbreviation -Voice, Reading - Reading for Inferences, Writing - Agenda Note - taking - Editing the text, Listening - Listening to Telephonic Conversation, Speaking - short talks on general topics, short conversations.

Total Periods 45

Text Books

1. Jack.C.Richards, interchange (fourth edition), Cambridge University Press, New Delhi. 2015

References

1. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan, Chennai. 2011
2. www.usingenglish.com
3. www.grammar.org

4. www.audioenglish.com
5. http://www.manythings.org
6. www.onestopenglish.com
7. www.learnenglish.com

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1										3		3		1		
CO2										3		2				
CO3										3		3				
CO4					2					3		3				2
CO5										3		3				1
CO6										3		2				
CO7									2	3		2				2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA11	ENGINEERING MATHEMATICS - I	L-T-P	C
		3-1-0	4

Programme: B.E/B.TECH. Common to all Branches **Sem: I Category: BS**

Prerequisites: Nil

AIM: The Course is aimed at Developing the basic mathematical skills of Engineering Student

Course Outcomes:

The Students will be able to

CO1: Able to find the inverse of given matrix and reduce matrix equation using Cayley-Hamilton Theorem.

CO2: Elaborate given function as a power series using Taylor's series.

CO3: Develop a series solution to an ODE, and recognize special functions defined by series.

CO4: Make use of Calculus in finding the envelope, Evolutes & Involutes.

CO5: Able to check whether the series is convergent or divergent.

CO6: Evaluate maxima and minima for function of two variables.

MATRICES **12**

Characteristic equation - Eigen Values and Eigen vectors of a real matrix - Properties of Eigen values-Cayley-Hamilton Theorem (without proof) and its application - Orthogonal Transformation of a Symmetric matrix to diagonal form - Quadratic form - Orthogonal reduction to canonical form.

ORDINARY DIFFERENTIAL EQUATIONS **12**

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.

DIFFERENTIAL CALCULUS **12**

Curvature - Radius of curvature - Cartesian and Parametric Coordinates - Circle of Curvature - Involutes and Evolutes – Envelope.

FUNCTIONS OF SEVERAL VARIABLES **12**

Partial Derivatives - Total Derivative - differentiation of Implicit function – Jacobian - Taylor's Expansion - Maxima/Minima for function of two variables - Method of Lagrange's multipliers

SEQUENCES AND SERIES **12**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test and D'Alembert's ratio test – Alternating series – Leibnitz's test - Series of positive and negative terms – Absolute and conditional convergence.

Total Periods (Theory 45 + Tutorial 15) 60

Text Books

1. B.S.Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. Veerarajan.T "**Engineering Mathematics(for first year)**",Fourth Edition, Tata McGraw – hill publishing company Ltd, New Delhhi,2005

References

1. Greenberg, M.D. **"Advanced Engineering Mathematics",** Second Edition, Pearson Education Inc. (First Indian reprint), 2002.
2. Venkataraman.M.K., "**Engineering Mathematics**", Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Dr.P.Kandasamy, Dr.K.Thilagavathy, Dr.K.Gunavathy, S.Chand & Company Ltd. Ram Nagar, New Delhi.

4. Ravish R Singh, Mukul Bhatt, **"Engineering Mathematics-I",** McGraw Hill Education (India) Private Ltd, New Delhi.
5. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.

Course Outcomes	Program Outcomes (POs)(Bio-Technology)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		1								2				
CO2	2	3		2								1				
CO3	3	3										3				
CO4	1	1														
CO5	3	2		1												
CO6	2	2		1								3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PH11	ENGINEERING PHYSICS	L-T-P	C
		3-0-0	3

Programme: B.E/B.TECH. Common to all Branches **Sem: I** **Category: BS**

Prerequisites: Nil

AIM: To endow the students with the fundamentals of Physics and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

The Students will be able to

CO1: Understand the theory and various crystal structures and crystal growth techniques.

CO2: Acquire knowledge about the properties of sound and effect of sounds within the building.

CO3: Attain the knowledge of ultrasonic waves and their application in the field of Non-destructive testing and Sonogram.

CO4: Gain knowledge about basic equations of Quantum mechanics and its applications.

CO5: Familiarize with basic configuration of a Laser, types of lasers and the industrial applications of Laser.

CO6: Measure the principle behind fiber optic communication and the electronic devices involved in the transmission and reception of data.

CRYSTAL PHYSICS **9**

Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - d spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing factor for SC, BCC, FCC and HCP structures - Crystal growth techniques - Solution, melt (Bridgemann and Czochralski).

ACOUSTICS **9**

Classification of sound – Decibel - Weber- Fechner Law - Sabine's formula - Derivation using growth and decay method - absorption coefficient and its determination - Acoustic of building - Factors affecting acoustics of buildings and their remedies.

ULTRASONICS **9**

Production of Ultrasonics - Magnetostriction - Piezoelectric methods - Velocity measurement - Acoustic grating - Industrial applications - Non Destructive Testing - Pulse echo system through transmission and reflection modes - SONAR, Medical applications - Sonograms.

QUANTUM PHYSICS **9**

Black body radiation - Planck's theory (derivation)- Photoelectric effect - Matter waves - Schrödinger's wave equation - Time independent and time dependent equations - Physical significance of wave function - Particle in a one dimensional box.

9

LASERS: Introduction - Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einsteins A and B co-effcients – Derivation - Types of lasers - CO_2, Nd-YAG - Industrial Applications - Lasers in welding, cutting - Holography and its applications.

FIBER OPTICS: Optical Fiber - Classification- Principle and propagation of light in optical fibres - Numerical aperture and Acceptance angle - Fibre optical communication system - Sensors (Active and passive) - Displacement and Temperature Sensors.

Total Periods 45

Text Books

1. Gaur R. K., Gupta S. C., "Engineering Physics" Dhanpat Rai Publications, New Delhi (2003).
2. Avadhanulu M. N., Kshirsagar, P. G., "A Text book of Engineering Physics", S.Chand and company, Ltd., New Delhi, 2005.

References

1. Serway and Jewett., "Physics for Scientists and Engineers with Modern Physics", 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)
2. Arither Beiser, Concepts of Modern Physics, Tata McGraw Hill, New Delhi (2010)
3. Palanisamy, P.K., "Engineering Physics" Scitech publications, Chennai, (2007).
4. Rajendran, V and Marikani A, "Engineering Physics" Tata McGraw Hill Publications Ltd, III Edition, New Delhi, (2004).
5. Chitra Shadrach and Sivakumar Vadivelu, "Engineering Physics", Pearson Education, New Delhi, (2007).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1		1					1				
CO2	3	1	2	1	1		1					1				
CO3	3	1	1	2	1		1					1				
CO4	3	2	2	2	2		2					1				
CO5	3	2	2	3	2		1					2				
CO6	3	2	2	1	2		1					2				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CY11	ENGINEERING CHEMISTRY	L-T-P	C
		3-0-0	3

Programme: B.E/B.TECH. Common to all Branches **Sem: I** **Category: BS**

Prerequisites: Nil

AIM: To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

Course Outcomes:

The Students will be able to

CO1: Demonstrate the essential concept of water chemistry with their properties and applications of water technology.

CO2: Describe the treatment of water for potable and industrial purposes.

CO3: Understand the operating principles and the reaction involved in electrochemistry.

CO4: Explain the core concepts of surface chemistry.

CO5: Illustrate the structure, properties and applications of nanomaterials.

CO6: Learn the principles, importance and application of analytical techniques.

WATER TECHNOLOGY **9**

Hardness - Types and Estimation by EDTA method, alkalinity - types of alkalinity and determination - Domestic water treatment - disinfection methods (Chlorination, ozonation, UV treatment) - Boiler feed water - requirements - disadvantages of using hard water in boilers - internal conditioning (phosphate, calgon and carbonate conditioning methods) - external conditioning - demineralization process - desalination and reverse osmosis.

ELECTROCHEMISTRY **9**

Electrochemical cells - reversible and irreversible cells - EMF - electrochemical series and its significance-Single electrode potential - Nernst equation (problem) - reference electrodes - Standard Hydrogen electrode - Calomel electrode - Ion selective electrode - glass electrode and measurement of pH - potentiometer titrations (redox - Fe^{2+}vs dichromate) and conductometric titrations (acid-base - HCI vs NaOH) titrations.

SURFACE CHEMISTRY **9**

Adsorption - types - adsorption of gases on solids - adsorption isotherms - Frendlich and Langmuir isotherms - adsorption of solutes from solution - role of adsorbents in catalysis, ion-exchange adsorption and pollution abatement.

NANOCHEMISTRY **9**

Nanomaterials - introduction to nanochemistry - synthesis - hydrothermal, solvothermal - Chemical vapour deposition - sol-gel - Electro deposition - ball milling - properties of nanoparticles and applications. Carbon nanotubes - fabrication - arc method - pulsed laser deposition - Chemical vapour deposition - structure, properties & applications.

SPECTROSCOPY & QUANTITATIVE ANALYSIS **9**

Beer-Lambert's law (problem) - UV-Visible spectroscopy and IR spectroscopy - principles - instrumentation (problem) (block diagram only) - estimation of iron by colorimetry - Determination of the amount of calcium in milk powder by EDTA Complexometry - Estimation of iodine in iodized common salt by Iodometry - Estimation of phosphoric acid in soft drinks (coca cola) by molybdenum blue method .

Total Periods 45

Text Books

1. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009.
2. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002)

References

1. S.S. Dara, S.S. Umare, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi, 2010.
2. B.K.Sharma, “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
3. B.Sivasankar, “Engineering chemistry” Tata McGraw Hill Publishing Company (P) Ltd., New Delhi, 2006.
4. Pradeep, “Nano the essential” McGraw Hill Publishing Company (P) Ltd., New Delhi,

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2		2	3			2		3				
CO2	3	2		2	2	3		1	2		2	2				
CO3				2			2					2				
CO4	2	1	2	2	1		2					1				
CO5	3	2	2	1	2	1			2			2				
CO6	3	3	3	2		2	3			2		3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CS11 **COMPUTER PROGRAMMING** **L-T-P C**
3-0-0 3
Sem: I **Category: ES**

Programme: B.E/B.TECH. Common to all Branches

Prerequisites: Nil

AIM: To provide an awareness to Computing and Programming

Course Outcomes:

The Students will be able to

CO1: Learn the fundamental knowledge on basics of computers hardware and number systems.
CO2: Understand the basic terminology used in computer programming.
CO3: Perform to write, compile and debug programs in C language.
CO4: Apply different data types in a computer program.
CO5: Design programs involving decision structures, loops and functions.
CO6: Describe the dynamics of memory by the use of pointers.
CO7: Apply the different data structures and create/update basic data files.

INTRODUCTION **9**

Generation and Classification of Computers- Basic Organization of a Computer – Number System – Binary – Decimal – Conversion – Problems. Software – Types, Development Steps. Algorithm – Pseudo code – Flow Chart. Problem formulation – Problem Solving.

C PROGRAMMING BASICS **9**

Introduction to Unix Operating System – Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

FUNCTIONS AND POINTERS **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays - Example problems.

STRUCTURES AND UNIONS **9**

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Union – Programs using structures and Unions – File Manipulation – Storage classes – Pre-processor directives.

Total Periods 45

Text Books

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. PradipDey, ManasGhosh, "Fundamentals of Computing and Programming in C", 1/e, Oxford University Press, 2009.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 13/e, 2011.

References

1. Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie ,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											1	2		
CO2	3	2												2		
CO3	3	3	2	1						1			2			
CO4	3	2	1													2
CO5	2	2	3	2										2		
CO6	2	2			1								1			
CO7	2	2	2	2	1								1			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161ME11 **ENGINEERING GRAPHICS** **L-T-P C**
1-0-3 3
Sem: I **Category** ES

Programme: B.E./B.Tech. Common to All Branches

Prerequisites: Basic knowledge in geometrical drawing

Aim: To develop graphics skills in students

Course Outcomes:

The Students will be able to

CO1: Follow the conventions used in engineering graphics.
CO2: Practice plane curves and free hand sketching.
CO3: Draw the projections of points, lines and plane.
CO4: Draw the projections of simple solids and their sectional views.
CO5: Describe the applications of development of surfaces.
CO6: Practice isometric and perspective projections.

Concepts and conventions (Not for Examination) **12**

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

PLANE CURVES **12**

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

PROJECTION OF POINTS, LINES AND PLANE SURFACES **12**

Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations– Projection of regular polygonal and circular lamina inclined to both reference planes.

PROJECTION OF SOLIDS **12**

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **12**

Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section. Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone.

ISOMETRIC AND PERSPECTIVE PROJECTIONS **12**

Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone. Perspective projection of simple prism and pyramid by Visual ray method

Total Periods: 60

Text Books:

1. K.V.Natrajan, "A text book of Engineering Graphics**",** Dhanalakshmi Publishers, 2015
2. M.S. Kumar, **"**Engineering Graphics**",** D.D. Publications, (2014)

References:

1. K. Venugopal and V. Prabhu Raja, **"Engineering Graphics",** New Age International (P) Limited (2015)
2. M.B. Shah and B.C. Rana, **"Engineering Drawing",** Pearson Education (2014)
3. K.C. John, **"Engineering Graphics for degree"** PHI Learning Pvt. Ltd., (2013)
4. Basant Agarwal and Agarwal C.M., **"Engineering Drawing",** Tata McGraw Hill Publishing Company Limited, New Delhi, (2013)
5. Gopalakrishna K.R., "Engineering Drawing" (Vol.I & II combined), Subhas Stores, 2014.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 and 1) – 2001: Technical products Documentation – Lettering
3. IS 10714 (Part 20) – 2001 and SP 46 – 2003: Lines for technical drawings
4. IS 11669 – 1986 and SP 46 – 2003: Dimensioning of Technical Drawings
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

Special points applicable to end semester examination on Engineering Graphics:

1. There will be five questions, first question is compulsory from Unit-I on engineering curves. Other four questions are either or type from Unit-II to V.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The end semester examination will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3		3		3					1				2		
CO2	3		2		2					1						1
CO3	3		2		3					1			1			
CO4	3		3		2					1			1			
CO5	3		3		3					1						1
CO6	2		2		3					1			1			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PC17	PHYSICS AND CHEMISTRY LABORATORY-I	L-T-P	C
		0-0-3	2

Programme: B.E/B.TECH. Common to all Branches **Sem: I** **Category: BS**

Pre/Corequisites: Engineering Physics & Engineering Chemistry

AIM: To introduce the basic Physics concepts through experiments and to impart the basic analysis in chemistry.

Course Outcomes:

The Students will be able to

CO1: Understand the laser light propagation in optical fibre
CO2: Learn the principle of interference
CO3: Gain the knowledge of ultrasonic velocity in a liquid medium.
CO4: Understand the knowledge of their home town water
CO5: Estimate the amount of substance by potentiometric technique
CO6: Outline the application of analytical instrument.

LIST OF EXPERIMENTS - PHYSICS PART **(A minimum of five experiments shall be offered)**		
S.No	**NAME OF THE EXPERIMENT**	
1.	(a) Determination of Particle Size using Diode LASER. (b) Determination of wavelength of the LASER source. (c) Determination of Acceptance angle and Numerical aperture ofan optical fibre.	3
2.	Determination of thickness of thin wire – Air wedge method.	3
3.	Determination of Velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	3
4.	Determination of Dispersive power of a prism using Spectrometer.	3
5.	Determination of Young's modulus of the material - Non uniform bending.	3
6.	Determination of thermal conductivity of a bad conductor - Lee's Disc method.	3

LIST OF EXPERIMENTS – CHEMISTRY PART		
S.No	**NAME OF THE EXPERIMENT**	
1.	Estimation of Total Hardness of their home town water by EDTA method.	3
2.	Estimation of Copper in brass solution by EDTA method.	3
3.	Estimation of Ferrous Ion by Potentiometric Titrations.	3
4.	Conductometric titration of strong acid vs strong base.	3
5.	Estimation of Alkalinity of water sample.	3
6.	Estimation of Iron by spectrophotometer (Demo only)	3

References

1. Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS, London.
2. "Practical A. Ravikrishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002).
3. Engineering Physics Laboratory Manual.
4. Engineering Chemistry Laboratory Manual.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1		2		1					1		2		
CO2	1	2	2				1					1				1
CO3	2	2	2				1					1	1			
CO4	2	2	1		1		2					1	1			
CO5	3	2	1	2	2		1					2				1
CO6	2	1	3		2		2					2	1			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CS17	COMPUTER PRACTICES LABORATORY	L-T-P	C
		0-0-3	2

Programme: B.E/B.TECH. Common to all Branches **Sem: I** **Category: ES**

Pre requisites:

AIM: To provide an awareness to Computing and C Programming

Course Outcomes:

The Students will be able to

CO1: Perform fundamental concept on basics commands in Linux.
CO2: Write, compile and debug programs in C language.
CO3: Formulate problems and implement algorithms in C.
CO4: Choose programming components that efficiently solve computing problems in real-world.
CO5: Design application oriented programs in C.
CO6: Apply Structures and unions through which derived data types can be formed.

LIST OF EXPERIMENTS

S.No

1. eSearch, generate, manipulate data using MS office/ Open Office,
2. Presentation and Visualization – graphs, charts, 2D, 3D,
3. C Programming using Simple statements and expressions.
4. Scientific problem solving using decision making and looping.
5. Simple programming for one dimensional and two dimensional arrays.
6. Solving problems using String functions
7. Programs with user defined functions – Includes Parameter Passing,
8. Program using Recursive Function and conversion from given program to flow chart.
9. Program using structures and unions.
10. Program using files,

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2						2				3	1	1	
CO2	3	2	2						2				3	2	2	
CO3	3	2	3						2				3	3	2	
CO4	2	3	2						2				3	2	2	2
CO5	3		2						2				3	2	1	
CO6	2		2										2	2	1	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161EE17	ENGINEERING PRACTICES LABORATORY	L-T-P	C
		0-0-3	2
Programme:	B.E/B.TECH. Common to all Branches	**Sem: I**	**Category: ES**

Prerequisites:

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

Course Outcomes:

The Students will be able to

CO1. Express the pipe connections and identify the various components used in plumbing.
CO2. Produce simple wooden joints using wood working tools.
CO3. Create simple lap, butt and tee joints using arc welding equipment's.
CO4. Generate the simple components using lathe and drilling machine.
CO5. Identify the fitting usage of square joint, L joint and stepped joints.
CO6. Facilitate the operation of fluorescent lamp, staircase wiring and measuring the consumed electrical energy.
CO7. Express and analyse the fundamentals of Boolean Algebra and digital logic gates.
CO8. Generate clock signal and measure the parameters of the signal.

LIST OF EXPERIMENTS

GROUP A (CIVIL and MECHANICAL)

I CIVIL ENGINEERING PRACTICE 12

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Preparation of plumbing line sketches for water supply and sewage works.
c) Hands-on-exercise.
d) Basic pipe connections – Mixed pipe material connection – Pipe.
e) Connections with different joining components.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise: Dismantling & Assembling of various wooden furniture like stool, Chairs & Bench.

II MECHANICAL ENGINEERING PRACTICE 12

Welding:

a) Preparation of arc welding of butt joints and lap joints.
b) Study of Gas welding equipment & practice.

Fitting:

a) Hands-on-exercise: Preparation of square fitting, vee & step – fitting models.

III GROUP B (ELECTRICAL and ELECTRONICS) 12

Electrical:

a) Residential house wiring using switches, fuse, indicator, lamp and energy meter.
b) Fluorescent lamp wiring.
c) Stair case wiring

d) Measurement of electrical quantities – voltage, current, power and power factor in RLC circuit.
e) Measurement of energy using single phase energy meter.

Electronics:

(a) Study of Electronic components and equipments – Resistor, colour coding.

(b) Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3	3				3							
CO2	2	2	3	3	3				3							
CO3	2	2	3	3	3				3							
CO4	2	2	3	3												
CO5	2	2	3	3												
CO6	2		2													
CO7	2	2	3	3												
CO8	2	2	3	3	3				3							

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS21	TECHNICAL ENGLISH	L-T-P	C
		3-0-0	3

Programme: B.E/B/Tech (Common to all Branches) **Sem II** **Category: HS**

Prerequisites: 161HS11 ESSENTIAL ENGLISH

AIM: To improve confident of the learner to communicate effectively using technical related workplace modules.

Course Outcomes:

The Students will be able to

CO1: Remember words and its meaning for the specific purpose.
CO2: Apply written communication methodologies at workplace.
CO3: Develop listening skill to respond and to gather information.
CO4: Interpret the text using comprehending skill.
CO5: Describe the topic using appropriate vocabulary.
CO6: Summarize the key points in the audio script.
CO7: Evaluate the uses of different vocabulary in use.

Language and Grammar - Technical Words-Foreign Words-Adjective **Reading** - Reading **Technical** Passages **Writing** - Formal Letters-Calling for Quotation, placing order **Listening** - Listening to TED Talks to take Notes – **Speaking** - Introducing others. **9**

Language and Grammar - Interrogative Statements – Acronym – One - word substitution **Reading** - Note-taking – **Writing** - Essay writing - Preparing Questionnaire **Listening** - Listening to Group Discussion **Speaking**- Public Speech practice. **9**

Language and Grammar - Conditional Clauses - Punctuation - Concord **Reading** - Reading Book/film/music reviews **Writing** - Report Writing **Listening** - Listening to Technical Presentation **Speaking**- Reporting events **9**

Language and Grammar - Words followed by Prepositions-Articles-Action verb **Reading** - Reading Famous speech text **Writing** – Minutes – Checklist - Memo **Listening** - Listening for Gist **Speaking** - discussing about uses of gadgets & machines. **9**

Language and Grammar Vocabulary, cause and effect, reported speech Reading - Reading for vocabulary **Writing** - dialogue writing **Listening** - Listening for Gist **Speaking** - discussing about uses of gadgets & machines. **9**

Total Periods 45

Text Books

1. Department of English, Anna University, ‘ English for engineers and technologists’(Vol. 1& 2) combined edition, Orient Black swan, Chennai 2012

References

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012

1. www.usingenglish.com
2. www.grammar.org
3. www.audioenglish.com
4. http://www.manythings.org

Course outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2		3		1		2	3	3	3	3				2
CO2						2		3	3	3	3	3			1	
CO3		3		2	3	2	3	2	3	3	2	3		1		
CO4										2		3				
CO5									3	3	2	3				1
CO6			2	2								3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA21	ENGINEERING MATHEMATICS - II	L-T-P	C
		3-1-0	4

Programme:	B.E/B.TECH. Common to all Branches	**Sem**	**II**	**Category:**	**BS**
Prerequisites:	Engineering Mathematics-I				
AIM:	To analyze the engineering problems using the techniques and the mathematical skills acquired by studying vector calculus, Laplace transform, complex variables and multiple integral.				

Course Outcomes:

The Students will be able to

CO1: Apply Laplace transform to solve first and second order differential equations with elementary forcing function.

CO2: Classify Green's theorem to evaluate line integrals along simple closed contours on the plane.

CO3: Construct an analytic function using the properties of analytic function.

CO4: Make use of Cauchy's residue theorem for applications in Engineering.

CO5: Evaluate complicated real integrals using the basics of analytic functions and the complex Integration.

CO6: Apply double integration to find area between two curves.

LAPLACE TRANSFORM **12**

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – First Shifting Theorem -Transform of derivatives on tf (t), f(t)/t and periodic functions – Transform of unit step function and impulse functions. Inverse Laplace transform by partial fraction method and Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

ANALYTIC FUNCTIONS **12**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy– Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function (without proof) – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w = z+c, cz, 1/z, and bilinear transformation.

COMPLEX INTEGRATION **12**

Statement and application of Cauchy's theorem and Cauchy's integral formula, Taylor and Laurent expansion, Singularities, Classification, Residues, Cauchy's residue theorem, Contour integration (Type I & II).

MULTIPLE INTEGRALS **12**

Double Integration – Cartesian and Polar co-ordinates – Change of order of Integration - Change of variable between Cartesian and polar co-ordinates – Triple integration – Area as a double integral by Cartesian co-ordianates – Volume as a triple integral.

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 parallelepipeds.

Total Periods (Theory 45 + Tutorial 15) 60

Text Books

1. B.S.Grewal, 'Higher Engineering Mathematics', Thirty Sixth Edition, Khanna Publishers, Delhi, 2005.
2. T. Veerarajan, "Engineering Mathematics(for first year)",Fourth Edition, Tata McGraw – hill publishing company Ltd, New Delhi, 2005.

References

1. Greenberg. M.D. "Advanced Engineering Mathematics, Second Edition, Pearson Education Inc. (First Indian reprint), 2002
2. Venkataraman.M.K., "Engineering Mathematics", Volume I and II Revised enlarged Fourth Edition, The National Publishing Company, Chennai, 2004.
3. Kreyszig, E., Advanced Engineering Mathematics, 8th edition, John Wiley Sons, 2001.
4. Ravish R Singh, Mukul Bhatt, **"**Engineering Mathematics-I**",** McGraw Hill Education(India) Private Ltd, New Delhi.
5. Dr.P.Kandasamy, Dr.K.Thilagavathy, Dr.K.Gunavathy,S. Chand & Company Ltd. Ram Nagar, New Delhi.

Course Outcomes	Program Outcomes (POs)(Bio-Technology)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1								3		2	1	
CO2	2	2		2												1
CO3	2	1		2								1	2			
CO4	1	2		3								1			2	
CO5	3	3												2		
CO6	3	3			3				1			3	2			2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PH21	PHYSICS OF MATERIALS	L-T-P	C
		3 0 0	3

Programme: B.E./B.Tech (Common To All Branches) **Sem:** II **Category:** BS

Prerequisites: Engineering Physics

Aim: To endow the students with the fundamentals of physics, materials and apply new ideas in the field of Engineering and Technology.

Course Outcomes:

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

CO1: Understand the theory and processing of conducting, superconducting materials.

CO2: Acquire knowledge of classification of semi conducting materials.

CO3: Gain knowledge about the types of magnetic and dielectric materials and their applications.

CO4: Understand about some exciting properties of modern engineering materials.

CO5: Acquire knowledge about nanomaterial's and their properties and applications.

CO6: Attain a clear view of material characterization techniques.

CONDUCTING MATERIALS **9**

Conductors: classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory –Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

Super Conductors: properties - Types of super conductors - Applications of superconductors – SQUID, cryotron, magnetic levitation.

SEMICONDUCTING MATERIALS **9**

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration– Hall effect –Determination of Hall coefficient – Applications.

MAGNETIC AND DIELECTRIC MATERIALS **9**

Magnetic Materials: Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications.

Dielectric Materials: Polarization - electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation –dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

ADVANCED MATERIALS **9**

Metallic glasses: Preparation, properties and applications.

Shape memory alloys (SMA): Characteristics - Properties of Ni-Ti alloy – Applications -Advantages and disadvantages of SMA. **Bio Materials:** Biomaterials and their Types – Uses of biomaterials – Biosensor.

NANOMATERIALS & CHARACTERIZATION TECHNIQUES **9**

Synthesis of nanomaterials – Chemical vapour deposition – Ball milling - Properties of nanomaterials and applications. Principle, Characterization and applications of X- Ray diffraction – Scanning Electron Microscope – Transmission Electron Microscope

TOTAL NUMBER OF PERIODS : 45

Text books:

1. Ragavan, V., **"Material science and Engineering"**, Prentice Hall of India (2004).

References:

1. Arumugam M., **"Materials Science",** Anuradha publications, Kumbakonam (2006).
2. William D. Callister, Jr., **"Material Science and Engineering",** John Wiley & Sons Inc., Seventh Edition, New Delhi (2010).
3. Charles P. Poole and Frank J. Ownen., **"Introduction to Nanotechnology"**, Wiley India (2007).
4. Charles Kittel., **"Introduction to solid state Physics"**, John Wiley & Sons, 7th editions, Singapore (2007).

Course Outcomes	Program Outcomes (POs) (Bio-Technology)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1		1					1	1	1	1	
CO2	3	1	2	1	1		1					1	1	1	1	2
CO3	3	1	1	2	1		1					1	1	1	1	1
CO4	3	2	2	2	2		2					1	1	1	1	2
CO5	3	2	2	3	2		1					2	1	1	1	
CO6	3	2	2	1	2		1					2	2	1	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161CY21	ENVIRONMENTAL SCIENCE AND ENGINEERING	L-T-P	C
		3-0-0	3

Programme: B.E. (Common To All Branches) **Sem:** II **Category:** BS

Prerequisites: Basic Science

Aim: To Impart the social groups and individuals to acquire knowledge of pollution and environmental degradation

Course Outcomes:

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

CO1: Understand the basic concepts of environment studies and natural resources.
CO2: Get knowledge about ecosystem and biodiversity.
CO3: Identify and analyse causes, effects and control measures of various types of pollution.
CO4: Understand the impact of social issues.
CO5: Analyse the social issues related to the environment.
CO6: Describe the Human population and the Environment.

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **9**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. dams and their effects on forests and tribal people–Energy resources: Growing energy needs, renewable (solar energy and wind energy) and non-renewable energy sources- Nuclear energy – fission and fusion reactions and light water nuclear reactor for power generation (block diagram only), Petroleum processing and fractions, LPG and Natural gas.

ECOSYSTEM AND BIODIVERSITY **9**

ECOSYSTEM : Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem-Nitrogen cycle, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the Forest ecosystem and Aquatic ecosystems (lake and rivers) – **BIODIVERSITY** : Introduction to Biodiversity – Definition – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –India as a mega-diversity nation – Hot-spots of biodiversity.

ENVIRONMENTAL POLLUTION **9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) Thermal pollution – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **9**

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, Ozone layer depletion, nuclear accidents -case studies- Goal of Green chemistry.

HUMAN POPULATION AND THE ENVIRONMENT **9**

Population growth, variation among nations – Population explosion – Family Welfare Programme – Human Rights – Value Education – HIV/AIDS –Women and Child Welfare – Role of Information Technology in Environment and human health-Case studies.

TOTAL NUMBER OF PERIODS : 45

Text books:

1. Ravikrishnan, "Environmental Science and Engineering, Sri Krishna Hitech Publishing Company Private Limited, 2010.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

References:

1. Anubha Kaushik, C.P. Kaushik, "Environmental Science and Engineering", New Age International Publishers, 2016.
2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, 2006.
3. Raman Sivakumar, *Introduction to Environmental Science and Engineering*, Tata McGraw Hill Education Private Limited, New Delhi, 2010.
4. P.Meenakshi, Elements of Environmental Science and Engineering, PHI learning (P) Ltd., India.

Course Outcomes	Program Outcomes (POs) (Bio-Technology)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1					2	3	1								
CO2						2	2					2				
CO3		1				3	2					3				
CO4						3	2			1						
CO5			1			3	2			1		2				
CO6						1	2									

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT21 **BIOCHEMISTRY I** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 02** **Category: ES**

Prerequisites:

Aim: To enable students learn the basic fundamental of biochemical processes.

Course Outcomes:

CO1. Understand the basic design of life, classification, structure and function of bio molecules.
CO2. Describe the hierarchical organization of proteins and nucleic acid.
CO3. Apply the basic chemistry and classification of biomolecules.
CO4. Understand the enzyme catalyzed metabolic reactions and their regulation.
CO5. Calculate the energy transduction in metabolism of bio molecules.
CO6. Gain knowledge in the hierarchical organization of proteins and their metabolic pathways.

WATER **9**

Structure of water; noncovalent (weak) interactions - hydrogen bonding, ionic, hydrophobic, vander Waals, osmolarity and osmolality-introduction to buffering system and biological buffers-Cellular reactions of water- ionization-concept of pH, pK, acids and bases, Henderson-Hassel balch equation.

CARBOHYDRATES **9**

Nomenclature; structure, classification and functions of carbohydrates: monosaccharides –reactions - sugar derivatives; disaccharides – Structure and function- Polysaccharides-homo and hetero polysaccahrides- Glycosamino glyacans- glycoproteins- Bacterial cell wall polysaccharides.

LIPIDS **9**

Classification - structure and functions of lipids- Fatty acids – Nomenclature- Essential fatty acids- TAG structure and properties- Phospholipids – functions; Sphingo lipids and Glycolipids.Lipoproteins; Derived lipids – cholesterol – steroids-Properties of lipid aggregates.

AMINO ACIDS AND PROTEINS **9**

Classification, Structure and function of amino acids – Properties; Proteins – Classification – hierarchy of proteins – primary, secondary, tertiary and quaternary structure – Determination of primary structure; biologically important peptides.

NUCLEIC ACIDS AND VITAMINS **9**

Structure, functions and types of bases - purines and pyramidines; Nucleotides – Nucleosides- Structure of DNA and RNA-Vitamins – classification; biological importance, deficiency disorders and biochemical functions- Anti-oxidants and their role in biological systems.

Total Periods: 45

Text Books:

1. Nelson D.L., Cox M.M., "Lehninger's Principles of Biochemistry", 6th Edition. Macmillan worth Publisher, (2012).
2. Reginald H.Garrett, Charles M. Grisham, "Biochemistry" (2016).

References:

1. Berg J. M., Tymoczko J. L., Stryer, L., "Biochemistry" 7th Edition, Macmillon, (2012).
2. Moran L. A., Horton R.A., Scrimgeour G., Perry M., Rawn D., "Principles of Biochemistry" 5th Edition, Pearson New International Edition, (2014).
3. Voet D., Prat W.C., Voet J., "Principles of Biochemistry", John Wiley and Sons, 4th Edition (2012).
4. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P., "Harpers Illustrated Biochemistry" Mc Graw Hill, 30th Edition (2015).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	1	1	2					2	2	1	2	1
CO2	2	3	2	2	3	2	3	1		1	1	1	2	2	2	1
CO3	3	3	2	2	3	2	1			1	1	3	2	1	1	1
CO4	1	2	3	2	2	2	1				1	2	2	3	3	1
CO5	3	2	1	1	2	1	2				1	2	2	1	1	2
CO6	2	3	2	1	2	2		1		1	2	1	2	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT22	MICROBIOLOGY	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** 02 **Category:** PC

Prerequisites:

Aim: To develop skills of the students in the area of microbiology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

Course Outcomes:

CO1. Understand and analyze diversity of microorganisms.
CO2. Demonstrate the interaction of microorganisms with their environment.
CO3. Analyze how microorganisms cause diseases.
CO4. Select appropriate methods for control of the microorganisms.
CO5. Describe the principles of bacterial genetics.
CO6. Gain technical knowledge and make benefit into the microbiology based industry.

INTRODUCTIOM **9**

Basic of microbial existence - History of microbiology - Classification and nomenclature of microorganism - Microscopic examination of microorganisms - Light and Electron microscopy - Principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining.

MICROBES – STRUCTURE AND MULTIPLICATION **9**

Structural organization and multiplication of bacteria, viruses, algae and fungi with a special mention of life history of Actinomycetes, yeast, mycoplasma and bacteriophage.

MICROBIAL NUTRITION, GROWTH AND METABOLISM **9**

Nutritional requirements of bacteria and different media used for bacterial culture - Growth curve and different methods to quantitative bacterial growth - aerobic and anaerobic cultivation of microbes.

CONTROL OF MICROORGANISMS **9**

Physical and chemical control of microorganisms - Host-microbe interactions - Anti- bacterial, anti-fungal and anti-viral agents, Mode of action and resistance to antibiotics - Clinically important microorganisms.

ENVIRONMENTAL MICROBIOLOGY **9**

Preservation of food - Biogas – Bioremediation - Leaching of ores by microorganisms - Bio-fertilizers and Bio- pesticides - Biosensors.

Total Periods: 45

Text Books:

1. Pelczar MJ., Chan ECS and Kreig NR., "Microbiology", Tata Mc Graw-Hill Edition, New Delhi, India. (2001)
2. Parija SC., "Textbook of Microbiology and Immunology", Elsevier India (2012).

References:

1. Talaron K., Talaron A., Casita, Pelczar and Reid, "Foundations in Microbiology", W.C. Brown Publishers. (1993).
2. Prescott LM., Harley JP., Klein DA., "Microbiology", 3rd Edition, W.C. Brown Publishers (1996).
3. Ronald M. Atlas., "Microbiological Media", 4th Edition, CRC Press (2010).
4. Carl A. Batt., "Encyclopedia of Food Microbiology", Elsevier (2015).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	2	2	3	1			1	1	2	1	2	1	1
CO2	1	2	3	2	2	1	1			1	2	1	2	2	3	1
CO3	1	2	2	2	2	2	2			1	2	2	2	3	2	1
CO4	2	2	3	2	1	2	2	1	1	1	2	2	3	2	2	1
CO5	1	2	1	2	2	2	2	1	1	1	2	1	1	2	3	1
CO6	2	2	2	1	1	2	2	1	1	1	1	2	1	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161PC27	PHYSICS AND CHEMISTRY LABORATORY-II	L-T-P	C
		0-0-3	2

Programme: Common to all Branches **Sem: II** **Category: BS**

Pre/Corequisites: Engineering Physics & Engineering Chemistry

AIM: To introduce the basic Physics concepts through experiments and to impart knowledge on the application of chemistry in engineering branches.

Course Outcomes:

The Students will be able to

CO1: Understand the rigidity modulus of the materials.

CO2: Learn the Young's modulus of the material.

CO3: Study the flow of liquid in capillary tube.

CO4: Determine the quantity of unknown solution by instrumental method.

CO5: Analyse the corrosion rate of an iron.

CO6: Determine the concentration of an identified analyse by volumetric analysis

LIST OF EXPERIMENTS - PHYSICS PART **(A minimum of five experiments shall be offered)**		
S.No	**NAME OF THE EXPERIMENT**	
1.	Torsional pendulum – Determination of rigidity modulus	3
2.	Determination of Young's modulus of the material – Uniform bending	3
3.	Determination of viscosity of liquid – Poiseuille's method.	3
4.	Determination of wavelength of mercury spectrum- Spectrometer Grating.	3
5.	Determination of Band Gap of a semiconductor material.	3
6.	Determination of specific resistance of a given coil of wire – Carey Foster Bridge.	3

LIST OF EXPERIMENTS – CHEMISTRY PART		
S.No	**NAME OF THE EXPERIMENT**	
1.	Esimation of HCl by pH metry	3
2.	Conductometric titration of mixture of acids (HCl& CH_3COOH)	3
3.	Estimation of Chloride ion in water sample by Argentometric method.	3
4.	Determination of molecular weight of a polymer by viscometry method	3
5.	Determination of corrosion rate by weight loss method	3

References

1. Text book of Quantitative Inorganic Analysis, A.I.Vogel, ELBS,London.
2. "Practical A. Ravikrishnan Engineering Chemistry", Sri Krishna Publications, Chennai (2002).
3. Engineering Physics Laboratory Manual.
4. Engineering Chemistry Laboratory Manual.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3	PSO4
CO1	2	2	1	1	1		1					1				
CO2	2	2	1	1	1		1					1				
CO3	2	2	1	1	1		1					1				
CO4	2	2	1	2	2		1					1				
CO5	3	2	2	2	2		2					2				
CO6	3	2	2	2	2		2					2				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT27 **BIOCHEMISTRY LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem: 02** **Category: ES**

Aim:

Course Outcomes:

The students will be able to

CO1. Develop skills in accurate weighing and other measurements.
CO2. Familiarize with physiochemical parameters calibration.
CO3. Qualitatively analyze and various biochemical components.
CO4. Understand basics and functional reactions of biomolecules.
CO5. Gain knowledge about chromatography techniques
CO6. Estimate the biological components by using different methods.

LIST OF EXPERIMENTS

1. Demonstration of use of volume and weight measurements devices.
2. Titration of weak acid-weak base.
3. Quantitative Test for carbohydrates.
4. Distinguish reducing and non-reducing sugars.
5. Using ninhydrin for distinguishing Imino and amino acids.
6. Protein estimation by Biuret method.
7. Protein estimation by Lowry's method.
8. Protein estimation by Bradford colorimetric methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acid by absorbance at 260nm and hyper chromicity.

Total Periods: 45

References:

1. Jeyaraman J., "Laboratory Manual in Biochemistry", New Age International Publi., 2nd Edition, 2011

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	2			3	2		1		2	1	1	1
CO2	3	2	2	2	3				1			1	1	2	1	1
CO3	1	2	2	1	2		1	1	2	1		2	1	1	1	2
CO4	2	3	1	3	1				2	2		2	2	2	2	1
CO5	2	3	1	1	2		2	1		2	1	2	2	1	2	2
CO6	2	3	3	2	2			3	2		1		2	1	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT28 **MICROBIOLOGY LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem: 02** **Category: ES**

Aim: To develop skills of the students in the area of microbiology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

Course Outcomes:

The students will be able to

CO1. Describe sterilization techniques and good laboratory practices in microbiology.

CO2. Demonstrate competency in isolation, subculture, identification and preservation of microbe using appropriate basic microbiology technique.

CO3. Evaluate the activity of antibiotics and disinfectant on microbial growth.

CO4. Observe different phases of microbial growth curve.

CO5. Demonstrate the effect of pH, temperature and irradiation on microbial growth.

CO6. Gain lab knowledge and make benefit into the microbiology based industry.

LIST OF EXPERIMENTS

1. Laboratory safety and sterilization techniques.
2. Microscopic methods in the identification of microorganisms.
3. Preparation of culture media–nutrient broth and nutrient agar.
4. Culturing of microorganisms–in broth and in plates (pour plates, streak plates, isolation and preservation of bacterial cultures).
5. Staining techniques–Gram and differential.
6. Quantitation of microorganisms.
7. Effect of disinfectants on microbial flora.
8. Isolation and identification of microorganisms from different sources–soil water and milk.
9. Antibiotic sensitivity assay.
10. Growth curve–observation and growth characteristics of bacteria and yeast.
11. Effect of different parameters on bacterial growth (pH, temperature &UV irradiation).

Total Periods: 45

References:

1. Baltimore: Williams & Wilkins., "Bergey's Manual of Systematic Bacteriology". (1984).
2. Benson H.J., "Microbiological Applications: Laboratory Manual in General Microbiology", McGraw-Hill, 12th Edition. (2011).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1		2	2	1	1	2	2	1	3	1	2	
CO2	1	2	2	2	1	1	2	1	1	1	2	2	2	2	2	1
CO3	1	2	1	3		2	1	2		1	2	2	1	3	3	1
CO4	2	2	1	2		2	1	1		1	1	2	2	2	3	1
CO5	3	2	1	2	1	2	2	1		1	2	1	1	1	2	1
CO6	2	1	2	2	2	2	2	2	1	1	2	2	3	2	3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA31	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION	L	T	P
		3	1	0

Programme: B.E./B.Tech. (Common to all branches) **Sem:** III **Category: BS**

Prerequisites: Engineering Mathematics-I , Engineering Mathematics II

AIM: The Course is aimed at Developing the basic mathematical skills of Engineering Student.

Course Outcomes:

The students will be able to

CO1: Classify the Fourier series and half range Fourier sine and cosine series.
CO2: Explain the Fourier transform and with their properties.
CO3: Determine Z-inverse transform using convolution theorem and partial fraction method.
CO4: Solve the partial differential equation by using Lagrange's linear equation.
CO5: Analyze separation of variable to solve linear partial differential equation.
CO6: Discuss the formation of partial differential equation.

FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis.

FOURIER TRANSFORMS **12**

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

PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations(without reducing the standard type) – Linear partial differential equations of second and higher order with constant coefficients.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

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

Z -TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

TOTAL: 60 PERIODS

TEXT BOOK(S)

1. Grewal, B.S, **"**Higher Engineering Mathematics", 40th Edition, Khanna publishers, Delhi, (2007).
2. Dr. G. Balaji."Transforms and Partial Differential Equation", Balaji Publishers, 12th Edition November 2016, Chennai.

REFERENCE(S)

1. Bali, N.P and Manish Goyal "A Textbook of Engineering Mathematics"**,** 7th Edition, Laxmi Publications (P) Ltd. (2007).
2. Ramana B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition-Pearson Education (2007).
4. Erwin Kreyszig "Advanced Engineering Mathematics", 8th Edition-Wiley India (2007).
5. Dr.P. Kandasamy, Dr.K.Thilagavathy, Dr.K.Gunavathy, S.Chand & Company Ltd. Ram Nagar,New Delhi.

Course outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	P02	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3								3		2	1	
CO2	2	3		3		2						3				1
CO3	1	2		3								3	2			
CO4	1	1		1				2						2	2	
CO5	1	1										1				
CO6	2	2											2			2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial(High)

161BT31 **STOCHIOMETRY AND FLUID MECHANICS** **L-T-P 4-0-0**

Programme: B. Tech Bio-Technology **Sem:** **03** **Category:** **PC**

Prerequisites:

Aim: The course aims to develop skills of the Students in the area of Chemical Engineering with emphasis in Thermodynamics fluid mechanics. This will be necessary for certain other course offered in the subsequent semesters and will serve as a prerequisite.

Course Outcomes:

After completion of this course students will be able to

CO1. Recall chemical operations and solve problems related to units and conversions and fit the given data using the methodologies.

CO2. Solve problems related to energy balance concepts, flow and design unit operation equipment and reactors for biochemical processes.

CO3. Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics.

CO4. Acquire knowledge related to fluid statics and dynamics, transportation of fluids in Chemical processes and Bioprocesses.

CO5. Gain knowledge about the flow through packed columns.

CO6. Analyze the process of centrifugal fluidization.

OVERVIEW OF PROCESS INDUSTRY **12**

System of units, conversion of units; fundamental concepts of stoichiometry; Introduction to fluid flow heat transfer and mass transfer operations; process automation; environment; conservation factors; applied mathematics for experimental curve fitting; numerical differentiation; integration**.**

MATERIAL BALANCES **12**

Conservation of mass and energy; unit operations and Overall and component balances; material balances without and with chemical reactions; degrees of freedom; steady and unsteady state; recycle and bypass; humidity calculations.

FIRST AND SECOND LAW OF THERMODYNAMICS **12**

Energy balances; sensible heat, latent heat; vapour pressure; steady and unsteady state calculations.

FLUID MECHANICS **12**

Fluids; fluid statics and applications in chemical engineering; fluid flow; laminar; turbulent pressure drops; compressible fluid flow concepts; multiphase flow concepts.

FLOW THROUGH PACKED COLUMNS **12**

Fluidization; centrifugal and piston pumps; characteristics; compressors; work**.**

Total Periods: 60

Text Books

1. Narayanan K.V., Lakshmikutty B.” Stoichiometry and process calculations”, 1st Edition, Prentice Hall India, 2006.
2. Mc Cabe W.L., Smith J.C, Harriot P. “Unit Operations in Chemical Engineering”, 7th Edition, Mc Graw-Hill Inc., 2014.

References

1. Himmelblau D.M., “Basic principles and calculations in Chemical Engineering”, Prentice Hall International, 8th Edition, 2011
2. Foust A.S., “Principles of Unit Operations”, John Wiley & Sons, 2nd Edition, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2				2	1			1		2	2	1	1	1
CO2	2	3	1	3	1	2	2	1		1	1	2	2	3	2	2
CO3	2	2	2	3	1	2	2	1		1	2	3	3	2	2	2
CO4	3	3	2	3			2		1	1	2	3	3	1	3	3
CO5	2	3	2	3	2	1	3		2	1		2	3	1	2	2
CO6	3	2		3			2		2				3		2	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT32 **CELL BIOLOGY** **L-T-P C**

4-0-0 4

Programme: B. Tech Bio-Technology **Sem: 03 Category: PC**

Prerequisites:

Aim: The course aims to develop skills of the Students in the area of Cell Biology and Cell Signalling pathways. This will be necessary for studies in course like Molecular course is also a prerequisite for other Biology, etc. offered in the subsequent semesters.

Course Outcomes:

After completion of this course students will be able to

CO1. Apply a basic core of scientific and quantitative knowledge to enhance understanding of cell structure and function at the molecular level.

CO2. Differentiate and identify microbial, plant and animal cells.

CO3. Explicate the transport phenomena across the plasma membrane.

CO4. Identify the cell machinery of signal amplification.

CO5. Develop knowledge on cell fraction and propagation methods.

CO6. Analyze basic principle and process of flow cytometry.

CELL STRUCTURAL ORGANISATION **12**

Eukaryotic and prokaryotic cells-Principles of membrane organization-Cytoskeletal proteins-Microtubules- Microfilaments- Intermediate Filaments- Structure and functions of Nucleus-Endoplasmic reticulum- Ribosomes- Golgi Complex- Lysosomes- Peroxisomes- Chloroplast & Mitochondria.

CELL DIVISION AND DIFFERENTIATION **12**

Overview of the Cell Cycle-Interphase-Mitosis-Meiosis and Cytokinesis-Animal Cell & Yeast Cell Division-Cell Cycle Control & Checkpoints-General Characteristics of Cell Differentiation-Historical events in Cell differentiation-Cytoplasmic determinants-Nucleoplasmic Interactions-Stem Cell differentiation and its Biological importance.

TRANSPORT ACROSS CELL MEMBRANES **12**

Passive &active transport- permeases- sodium potassium pump- Ca2+ATPase pumps- lysosomal and vacuolar membrane ATP dependent proton pumps-cotransport- symport- antiport- transport into prokaryotic cells- endocytosis and exocytosis-Entry of viruses and toxins into cells.

RECEPTORS AND SIGNAL TRANSDUCTION **12**

Cytosolic, nuclear and membrane bound receptors- role of secondary messengers-signal amplification-autocrine, paracrine and endocrine models of action- steroid / Peptide hormone regulation- tissue specific regulation- quantitation and characterization of receptors.

BASIC TECHNIQUES IN CELL BIOLOGY **12**

Cell fractionation and flow cytometry-morphometric measurement-localization of proteins in cells by immune staining techniques for the propagation of eukaryotic and prokaryotic cells- cell culture contamination and control measure.

Total Periods: 60

Text Books:

1. DeRobertis & DeRobertis, "Cell and Molecular Biology", 8th Edition, B.I.Publ. Pvt. Ltd, (2010).
2. Parija SC., "Textbook of Microbiology and Immunology", Elsevier India (2012)

References:

1. Darnell J., LodishH, Baltimore D, "Molecular Cell Biology", W.H. Freeman.
2. Kimball T.W.,"Cell Biology",Wesley Publishers.
3. James D. Watson., "Molecular Biology of the Cell".
4. Brian E.S Gunning, Martin W.steer, "plant cell biology", Jones and Bartcett publishers.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3		2	1	2			1		1	2	1	2	
CO2	1	2	1		1	2	2			1	1	2	2	1	2	1
CO3	2	1	1	2		1	2				1	2	2	1	2	
CO4	2	2	3	2	1	2	3				2	2	2	1	3	1
CO5	2	1	2		1			1		1	2	1	2	1	2	1
CO6	2	2	3	1	2	3	3	2			2	2	2	1	2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT33	PRINCIPLES OF GENETICS	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** 03 **Category:** PC

Aim: The course aims to enable students learn the basic and fundamental of genetics, to understand the basic of character transmission, segregation and expression; to introduce them prerequisite for genetic engineering and to analyse the role of genes and mutation

Course Outcomes:

After completion of this course students will be able to

CO1. Recall the Mendelian terms, gene inheritance and interaction.
CO2. Compare the gene arrangement in chromosomes and their mapping.
CO3. Analyze the process of gene exchange and role of transposons.
CO4. Predict mutation and its impact on variation, health and disorders.
CO5. Develop the fundamental techniques for genetic engineering.
CO6. Demonstrate the population and evolutionary genetic variation.

MENDELIAN GENETICS **9**

Mendels experiment and principle of segregation, monohybrid crosses – dominance, recessiveness, codominance, semi dominance and lethals; principle of independent assortment – dihybrid crosses, multiple alleles – ABO blood type and Rh factor alleles.

SEX DETERMINATION **9**

Linkage, crossing over and chromosomal mapping, Mechanism of sex determination, sex differentiation, sex linked inheritance, linkage of genes on x and y chromosomes, crossing over and chromosomal mapping in human recombination.

GENETIC MATERIAL AND GENETIC TRANSFER **9**

Identification of genetic material by Hersey & Chase, Avery, Mcleod and Fraenkel – Singer experiments; chromosome structure in prokaryotes and eukaryotes, recombination in bacteria – transformation, transduction and conjugation.

MUTATION AND CHROMOSOMAL INHERITANCE **9**

Mutations – spontaneous, physical and induced; applications of mutation, organization of DNA in mitochondria and plastids, cytoplasmic male sterility in plants.

POPULATION AND EVOLUTIONARY GENETICS **9**

Genetic variation, random mating and Hardy-Weinberg method, inbreeding, out breeding and assortative mating, genetic equilibrium and evolutionary genetics.

Total Periods: 45

Text Books:

1. Snustad D.P. and Simmons M.J., "Principles of Genetics", Wiley, 6th Edition, 2011

References:

1. Robert H.Tamarin, "Principles of Genetics" 7 ed., Tata McGraw Hill, 2002.
2. Daniel L., Hartl and Elizabeth W. "Essential Genetics" Jones, 3 ed., Jones and Bartlett publishers Massachusetts, 2002.

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	2	1			2	3	2		1		3		
CO2	1	1	3	2	2			1		1		2	2			
CO3	3	2	2	1	2		1	2	1	2					2	
CO4	1	2	2	3	1	1	1	2	1	1		2				1
CO5	2	3	1	1	2	1	2	1	2	2		3	2	2	1	2
CO6	3	1	2	3	2	1	2		2	2		1	2	2	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT34	ENZYME TECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem: 03** **Category: PC**

Prerequisites:

Aim: The course aims to develop skills of Students in the area of Organic Chemistry and its applications in Biology. This will be a prerequisite to courses like Molecular Modeling, Bio separations etc.

Course Outcomes:

After completion of this course students will be able to

CO1. Generalize the basics of enzymes nomenclature and theories.
CO2. Familiarize with the kinetics of enzyme action and inhibition.
CO3. Knowledge on immobilization of enzymes.
CO4. Acquire the production mechanism of enzymes from various source.
CO5. Analyze the Enzyme process and characterization.
CO6. Able to develop the production of biosensors.

INTRODUCTIOM TO ENZYMES **9**

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; Principles of catalysis – collision theory, transition state theory - Role of entropy in catalysis.

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 & models: substrate, product - Allosteric regulation of enzymes - Monod Changeux Wyman model - pH and temperature effect on enzymes & deactivation kinetics.

ENZYME IMMOBILIZATION **9**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., -examples, Matrix used in immobilization advantages and disadvantages.

PURIFICATION AND CHARACTERISATION OF ENZYMES **9**

Production and purification of crude enzyme extracts from plant, animal and microbial sources: precipitation, Dialysis, hydrophobic interaction chromatography, gel filtration, and ion exchange chromatography - Methods of characterization of enzymes- SDS-PAGE, X- Ray spectroscopy - Development of enzymatic assays.

ENZYME BIOSENSORS **9**

Principles of electrochemistry - Design of enzyme electrodes - Types of Biosensor and their application as biosensors in industry, healthcare and environment.

Total Periods: 45

Text Books:

1. Palmer T., Bonner P.L., "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", Elseveir, 2nd Edition, 2008.
2. Ashok P., Colin W., Carlos R.S., Christian L., "Enzyme Technology", Springer, 1st Edition, 2006.

References:

1. Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding; A.R. Fersht, W.H. Freeman, 1999.
2. Bioorganic Chemistry; H.Dugas, Springer Verlag, 1999.
3. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw-Hill.
4. Wiseman, "Enzyme Biotechnology", Ellis Horwood Pub.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3	1			1		1	1	2	2	2	2	1
CO2	1	2	2	2	3	1	1	1	2			1	1	3	2	1
CO3	2	1	1	3	2	2		2	1	1	1	1	1	2	2	2
CO4	1	3	2	2	1	1	1	2		2	2	2	2	2	2	1
CO5	2	2	1	1	1				1		1	1	1	2	2	1
CO6	1	2	1	1	1			1		2	1	1	2	3	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT35	BIOCHEMISTRY II			L-T-P	C
				4-0-0	4
Programme:	B. Tech Bio-Technology	**Sem:**	**03**	**Category:**	**PC**
Prerequisites:	161BT21 – Biochemistry I				

Aim: To develop skills of the students in Biochemistry with special emphasis on the metabolizing amino acids, nucleic acids, polysaccharide & lipids and bio membranes. This maybe a pre-requisite for certain-elective courses like Metabolic Engineering; Molecular Modelling and Drug Design etc.

Course Outcomes:

After completion of this course students will be able to

CO1. Compare the anabolic and catabolic pathways of amino acids and disorders associated with them.
CO2. Familiarize with the mechanism of protein transport to various destinations and degradation.
CO3. Analyze the mechanism of nucleic acid synthesis and degradation.
CO4. Explicit the intricate network of metabolic interactions to provide metabolic fuel and regulation of metabolism.
CO5. Know the physiological and metabolic significance of vitamins.
CO6. Gain knowledge about the clinical diseases.

INTRODUCTION TO METABOLISM **12**

Overview of metabolic pathways - anabolism, catabolism and amphibolism- Interconnection pathways-Chemistry of metabolism- concepts of bioenergetics- standard free energy change; High energy compounds-Respiratory chain – calculation of ATP molecules.

METABOLISM OF CARBOHYDRATES AND LIPIDS **12**

Glycolysis –citric acid cycle – gluconeogenesis – glycogenesis – glycogenolysis – Pentose phosphate pathway – glyoxalate cycle- Regulations- Biosynthesis of starch and glycogen-Glycogen storage diseases- Fatty acid biosynthesis and degradation-Cholesterol biosynthesis and ketone bodies formation.

METABOLISM OF AMINO ACIDS **12**

Nitrogen metabolism and urea cycle. Biosynthesis of amino acids- Gly, Met, Lys, Leu and aromatic amino acids. One-carbon Metabolism-Degradation of amino acids – Metabolic disorders associated with amino acid Metabolism-Biologically important molecules derived from amino acids.

METABOLISM OF NUCLEOTIDES **12**

Biosynthesis of nucleotides -de novo and salvage pathways for purines and pyrimidines, Degradation of proteins and nucleotides-Disorders caused by nucleotide metabolism-Hyperuricemia and gout, Hartnup's disease.

BIOCHEMISTRY OF CLINICAL DISEASES **12**

Diabetes mellitus-atherosclerosis, fatty liver, obesity, hormonal disorders, aging and inborn errors of metabolism- Organ function tests – Liver and kidney.

Total Periods: 60

Text Books:

1. David L. Nelson and Michael M Cox, Lehninger's Principles of Biochemistry, Macmillan Worth Publisher, 6th Edition, (2012)
2. Lubert Stryer, Biochemistry, 4th Edition, WH Freeman & Co., (2000).

References:

1. Voet and Voet, Biochemistry, 2nd Edition, John Wiley & Sons Inc., (1995).
2. Murray, R. K., Granner, B. K., Mayes, P. A., Rodwell. V. W., Harper's Biochemistry, Prentice Hal International.
3. Salway, J.G., Metabolism at a Glance,2nd Edition, Blackwell Science Ltd., (2000).
4. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P., "Harpers Illustrated Biochemistry" McGraw Hill, 30th Edition 2015.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	1							1	2	3	2	3	1
CO2	2	1	2	2								1	2	1	1	1
CO3	1	3	1					2				3	1	2	2	1
CO4	1	1	1								3	1	1	1	1	2
CO5	3	2	1	1					2		2	1	1	1	2	2
CO6	3	2	1	2				1			1	1		1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT37 **CELL BIOLOGY LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem:** **03** **Category:** **PC**

Course Outcomes:

The students will be able to

CO1. Apply and perform cell separation and identification.
CO2. Identify the different types of microscopes in cells identification.
CO3. Analyze viable, nonviable, plant and animal cells.
CO4. Identify various types of blood cellular component and various stages of mitosis using staining techniques.
CO5. Demonstrate the effect of osmosis and tonicity on red blood cells.
CO6 Demonstrate the effect of osmosis and tonicity

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation.
2. Principles of microscopy, phase contrast and fluorescent microscopy.
3. Identification of given plant, animal and bacterial cells and their components by microscopy.
4. Leishman staining.
5. Micrometry.
6. Giemsa Staining.
7. Separation of Peripheral Blood Mononuclear Cells from blood.
8. Osmosis and Tonicity.
9. Tryphan Blue Assay.
10. Staining for different stages of mitosis in Allium cepa (Onion).
11. Staining and observation of meiosis in testes of the grasshopper.

Total Periods: 45

References:

1. Harris J.R., Graham J.M., and Rickwood D., "Cell Biology: Essential Techniques", Wiley-Blackwell, 2006

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	1		2	2	3		3			3	3	2	1
CO2	2	3	1	3	2								3	2	3	1
CO3	1	3	1	3	2								3	3	3	1
CO4	2	3	1	2	1								3	2	3	1
CO5	2	3	1	2	3								3	2	1	1
CO6	3	2	1	1	2				2				3	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT38 BIO ORGANIC CHEMISTRY LABORATORY **L-T-P C**

0-0-3 2

Programme: B.Tech Bio-Technology **Sem: 03** **Category: PC**

Course Outcomes:

The students will be able to

CO1. Synthesize and characterize the organic molecule.
CO2. Perform screening and isolating biological enzymes.
CO3. Apply the various parameters regulating enzyme activity.
CO4. Able to develop immobilization techniques and inhibition kinetics.
CO5. Gain knowledge about the enzyme properties.
CO6. Analyze the characteristic features of milk.

LIST OF EXPERIMENTS

1. Synthesis of aspirin.
2. Hydrolysis of sucrose.
3. Preparation of pyruvic acid.
4. Isolation of lycopene from tomato paste.
5. Preparation of L-proline.
6. Preparation of L-cysteine from hair.
7. Screening and Isolation of enzyme.
8. Effect of pH, Temperature, Substrate on Invertase enzyme activity.
9. Protease assay study on Casein isolated from milk.
10. Enzyme Inhibition kinetics.
11. Cell and Enzyme immobilization.

References:

1. Pauline, D., "Bioprocess Engineering Principles", Elsevier, 2nd Edition, 2012

Total Periods: 45

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1		2	3					1	2	2	3	1
CO2	1	2	1	3	1							1	2	1	3	1
CO3	3	1	3	1		1						1	3	1	1	1
CO4	3	2	1	2					1			1	3	2	2	1
CO5	3	2	2	1	2	1	2					2	3	2	2	2
CO6	2	2	1	2	1	2	2			1		1	2	1	2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS39 **FUNCTIONAL ENGLISH – I** **L-T-P** **C**
0-0-2 **-**

Programme: Common to all branches **Sem** **3** **Category:** **EEC**

Aim: To create an Environment to improve learner's communication skill

Course Outcomes:

The students will be able to,

CO1. Impart basics of Language & Grammar relating to Business Communication.
CO2. Develop learner's ability to understand Technical communication.
CO3. Widen learner's ability to understand any kind of text.
CO4. Learn the nuances of effective writing by using short and crisp sentences.
CO5. Listen and comprehend talks and lectures on technical subjects.
CO6. Describe a process both in speaking and writing.

UNIT I **6**

GRAMMAR: Parts of Speech, Tense- simple present, perfect, continuous, present perfect continuous
READING: Reading different genres of text (literature, media and technical) for comprehension, reading for making inferences, reading news bulletins and weather forecast, advertisements
WRITING: Writing apology letters, writing e-mail – difference between formal and informal mails, giving information, making an enquiry, answering, announcing a job opportunity, enquiry, confirming terms, informing about a new service
LISTENING: Telephone etiquette- types of calls, greetings, making and receiving a call, transferring information, making appointments and closing a call. Listening to telephonic conversation, listening to famous personalities' speech
SPEAKING: **Role play**- planning a training course, phoning a hotel, enquiring about a new job, launching a new product, negotiating a deal and interviewing someone about a change in job. **Just a minute**- describing a business trip, the importance of internal communication of the company, describing a product and how it is advertised

UNIT II **6**

GRAMMAR: Simple past, perfect, continuous, past perfect continuous
READING: Reading technical article and making notes, Reading a technical report for gist
WRITING: Making and taking notes, writing project introduction, writing for giving assurance and Notice, Agenda and Minutes
LISTENING: Listening to documentaries, listening to interviews
SPEAKING: Small talks- introducing oneself, remembering one's childhood, describing one's positive and negative features, making comparisons, describing abilities and skills, making requests and seeking permissions

UNIT III **6**

GRAMMAR: Simple future, perfect, continuous, future perfect continuous. Voice. Conditional Clause
READING: Cloze test, Reading and answering questions, reading job advertisements, job interviews.
WRITING: Memos, writing user manuals, product review.
LISTENING: Listening to group discussion.
SPEAKING: Expressing personal opinion about social issues.

Total Periods: **18**

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2			2				3	3	3	3			1	
CO2					2	2			3	3	3	3		2		
CO3		2		2	2				3	3	3	3				
CO4					2				3	3	3	3				
CO5		2		3					3	3	3	3		1		1
CO6					2	2			3	3	3	3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161MA42	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

Programme: **B.E. Mechanical, Civil, EEE Engineering & Bio-Technology** **Sem: IV** **Category: ES**

Prerequisites: Engineering Mathematics-II, Transforms and Partial differential Equations.

Aim: To achieve high accuracy, many separate operate operation must be carried out.

Course Outcomes:

The students will be able to

CO1: Classify the tests for single variance and equality of variances.

CO2: Explain Eigen values of a matrix by Power method

CO3: Discover Numerical integration using Trapezoidal and Simpson's 1/3 rules.

CO4: Apply Newton's forward and backward difference interpolation.

CO5: Solution of ODE by Numerical method.

CO6: Boundary value problem by Numerical method.

TESTING OF HYPOTHESIS **12**

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

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **12**

Newton-Raphson method – Gauss Elimination method – Pivoting – Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigen values of a matrix by Power method.

INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTERGRATION **12**

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge- Kutta method for solving first and second order equations – Milne's predictor-corrector methods for solving first order equations – Finite difference methods for solving second order equation.

BOUNDARY VALUE PROBLEMS OF ORDINARY DIFFERENTIAL EQUATIONS **12**

Finite difference methods for solving second order ordinary differential equation- Finite differences solution of one dimensional heat equation by explicit and implicit methods - One dimensional wave equation and two dimensional Laplace and Poisson equations.

TOTAL: 60 PERIODS

TEXT BOOK(S)

1. Johnson, R.A., and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers"**,** Pearson Education, Asia, 7th edition, 2007.
2. G. Balaji, "Statistics and Numerical Methods", 11th Edition, G. Balaji Publishers, (2015).

REFERENCE(S)

1. Walpole, R.E., Myers,R.H., Myers,S.L., and KYe, "Probability and Statistics for Engineers and Scientists"**,** Pearson Education, Asia, 8th edition, (2007).
2. Spiegel,M.R., Schiller,J., and Srinivasan,R.A., "Schaum's Outlines Probability and Statistics"**,** Tata McGraw Hill edition, (2004)
3. Chapra, S.C., and Canale, R.P., "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, (2007).
4. Gerald, C.F., and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, (2006).
5. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, (2004).

Course outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	P0 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	1										1	2			2
CO2	2	2		2											1	
CO3	2	2		3								3		2		
CO4	1	1														2
CO5	3	2		3								1	2		2	
CO6	1	1		1										1		

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT41 **MOLECULAR BIOLOGY** **L-T-P C**

3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 04** **Category:** **PC**

Prerequisites:

Aim: Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes. This will be needed for any project work in modern biotechnology.

Course Outcomes:

After completion of this course students will be able to

CO1: Describe the role and significance of DNA as a genetic material.

CO2: Compare the Genetic, biochemical and biophysical aspects facilitate DNA and RNA to perform its biological function.

CO3: Familiarize the translation, transcription and replication are regulated in a coordinated fashion to operate the cellular machinery and life as a whole.

CO4: Interpret the biological functions due to changes at nucleotides by mutagenic agents.

CO5: Gain knowledge on gene repairing and regulation process.

CO6: Identify the mechanism of gene replication and transcription.

STRUCTURE OF NUCLEIC ACIDS **9**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3', 5'-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model. Different Types of DNA.

DNA REPLICATION **9**

Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson & Stahl experiment. Fidelity of DNA replication, Inhibitors of DNA replication, D-loop and rolling circle mode of replication. DNA mutation and Mutagens.

TRANSCRIPTION **9**

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

TRANSLATION **9**

Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis.

REGULATION OF GENE EXPRESSION IN PROKARYOTES AND EUKARYOTES **9**

Hierarchical levels of gene regulation, Regulation of gene activity In prokaryotes: Operon Concept: Lac operon, Trp Operon. Regulation of gene activity on eukaryotes.

Total Periods: 45

Text Books:

1. David Friefelder, Molecular Biology, 2nd Edition, Narosa Publ. House. 2008

References:

1. Benjamin Lewin, Gene VII, Oxford University Press, 2000.
2. Watson JD, Hopkins WH, Roberts JW, Steitz JA, Weiner AM, Molecular Biology of the Gene, 1987.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2		1	2	1		1	2		2		2	3	1	2	1
CO2	1	2	2	3	2	1	1					2	1	2	1	1
CO3	1	2	3	2	2	2	2	3	2	2			1	1	3	2
CO4	1	1	3	2	1		2			1			1	1	1	1
CO5	1	3	2		1	2							1	1	2	2
CO6	1	2	2	3	2	1	1	2	2	3		2	1	2	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT42 **UNIT OPERATIONS** **L-T-P C**

3-1-0 3

Programme: B. Tech Bio-Technology **Sem: 4** **Category: PC**

Prerequisites:

Aim: The course aims to develop skills of the Students in area of unit operations. This course will be a prerequisite for certain engineering subjects offered in the subsequent semesters.

Course Outcomes:

After completion of this course students will be able to

CO1. Analyze the purpose of mixing and agitation, type of agitators, scale up of agitators.
CO2. Perform the various mechanical- physical separation processes.
CO3. Describe the various modes of heat transfer process and its mechanisms.
CO4. Design the boiling and condensation process.
CO5. Compare and apply various types of heat exchanger and evaporators.
CO6. Gain knowledge about the field of process industries.

MIXING AND AGITATION **9**

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

FILTERATION **9**

Filtration rate, Constant pressure, factors affecting filtration, continuous filtration, industrial filters; settling and sedimentation; centrifugal filtration.

MECHANISM OF HEAT TRANSFER **9**

Basic law of conduction, Steady state conduction; unsteady state conduction; Combined heat transfer by conduction and convection.

CONVECTION HEAT TRANSFER **9**

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

HEAT EXCHANGERS **9**

Industrial heat exchangers, Double–pipe, shell-tube, extended surfaces, over all heat transfer coefficients; design of heat exchangers; NTU concept; evaporators; single and multiple effects; energy balances.

Total Periods: 45

Text Books:

1. McCabe W.L. Smith J.C. "Unit Operations in Chemical Engineering" 7th Edition McGraw Hill. 2014.
2. Geankoplis C.J. "Transport Processes and "Unit Operations" Prentice Hall India.2002.
3. P. Chattopadhyay, "Unit operations of chemical engineering" Volume 1, Khanna publishers.

References:

1. Incropera F.P. Fundamentals of Heat and Mass Transfer, John Wiley, 1998
2. Alan s Foust, Wenzel, Clump, Maus & Andersen "Principles of unit operations" 2nd edition, John wiley & Sons.
3. Treybal R.E., "Mass Transfer Operations", 3rd Edition, McGraw-Hill. (1981)

Course Outcomes	Program Outcomes (Pos)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2					1	1		1	2	1	3	1
CO2	2	3	2	3			1			2		1	3	2	1	2
CO3	3	2	1	3			1			2		1	3	2	1	1
CO4	3	3	2	3			1			2		1	2	3	1	2
CO5	3	3	2	3		2	2			2		1	3	3	3	1
CO6	2		1								2		2		3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

L-T-P C

161BT43 CHEMICAL ENGINEERING THERMODYNAMICS

3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 04 Category: PC**

Prerequisites:

Aim: The course aims to expose the students to the area of chemical thermodynamics. This will serve as a prerequisite for courses like enzyme engineering, Mass transfer, etc.

Course Outcomes:

After completion of this course students will be able to

CO1. Derive the thermodynamics property relations in accordance with laws of thermodynamics.
CO2. Appreciate the significance of solution thermodynamics.
CO3. Illustrate the phase equilibria and chemical reaction equilibria.
CO4. Investigate the potential applications of thermodynamics in real life scenario.
CO5. Relate the equilibrium relations between the different phases.
CO6. Familiarize about the thermodynamic analysis to the work.

THERMODYNAMIC PROPERTIES OF LIQUIDS 9

Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

SOLUTION THERMODYNAMICS 9

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

PHASE EQUILIBRIA 9

Criteria for phase equilibria; v-l-e calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

CHEMICAL REACTION EQUILIBRIA 9

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

THERMODYNAMIC ANALYSIS OF PROCESSES 9

Concept of lost work; entropy generation; calculation of real irreversible processes; power cycle; liquefaction.

Total Periods: 45

Text Books:

1. SmithJ.M., VanNess H.C., Abbot M.M. Chemical EngineeringThermodynamics.7th Edition. McGraw-Hill, 2012.
2. Narayanan K.V. "A Text Book Of Chemical Engineering Thermodynamics", 2nd Edition, Prentice Hall India, 2013.

References:

1. Sandler S.I. "Chemical And Engineering Thermodynamics" John Wiley, 1989.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3								1	2	2	2	1
CO2	3	3	2	3								1	2	2	1	1
CO3	3	3	2	2			2					1	2	1	2	1
CO4	1	2	1	1			2	2				2	3	3	1	1
CO5	1	2	2	1								2	1	2	2	1
CO6	1	1	1	2							2	1	2	1	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT44 ANALYTICAL METHODS IN BIOTECHNOLOGY L-T-P C

3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 04 Category: PC**

Prerequisites:

Aim: To develop skills of the students in the area of instrumentation in Biotechnology. This will be prerequisite for understanding specialized courses & project work that will be offered in the subsequent semesters.

Course Outcomes:

After completion of this course students will be able to

CO1. Infer the components of instruments, methods to calibrate and techniques to enhance signal noise ratio.
CO2. Characterize the biomolecules by Molecular spectroscopy.
CO3. Separate and purify biomolecules by exploiting their different physical and chemical properties.
CO4. Analyze the nature of chemical reactions during phase transition and the principle and application of freeze drying for preservation of food and microbial culture.
CO5. Demonstrate the principles of various instruments.
CO6. Learn about the various techniques solving research and industrial problems.

BASICS OF MEASUREMENT 9

Classification of methods – Calibration of instrumental methods – Electrical components and circuits – Signal to noise ratio–Signal – Noise enhancement.

OPTICAL METHODS 9

General design – Sources of radiation – Wavelength selectors – Sample containers–Radiation transducers – Types of optical instruments – Fourier transform measurements.

MOLECULAR SPECTROSCOPY 9

Measurement of transmittance and absorbance – Beer's law – Spectrophotometer analysis –Qualitative and quantitative absorption measurements - Types of spectrometers– UV–visible–IR –Raman spectroscopy– Instrumentation theory.

THERMAL METHODS 9

Thermo-gravimetric methods – Differential thermal analysis – Differential scanning calorimetry.

SEPERATION METHODS 9

Introduction to chromatography models – Ideal separation–retention parameters – Van–deemter equation – Gas chromatography–stationary phases – Detectors – kovats indices – HPLC–pumps–columns–detectors – Ion exchange chromatography – Size exclusion chromatography – Supercritical chromatography – Capillary electrophoresis.

Total Periods: 45

Text Books:

1. Willard, Merrit H., "Instrumental Methods of Analysis", Prentice hall of India, 7th Edition. (2012).
2. Skoog., "Principles of Instrumental Analysis" Brooks Cole, 6th Edition. (2007).

References:

1. Galen W. Ewing., "Instrumental Methods of Chemical Analysis", 5th Revised Edition, Mc Graw Hill Higher Education. (1985).
2. Pungor E., Horvai E., "A Practical Guide to Instrumental Analysis", CRC Press. (1994).
3. Douglas A. Skoog and Donald M, Thomson W.H., "Fundamentals of Analytical chemistry", 8th edition, Cengage Learning EMEA. (2003).
4. Wilson K., Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 7th edition. (2010).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	3	1			1			1	1	1	3	1
CO2	2	3	2	2	2						2	2	2	1	1	1
CO3	3	1	2	2	3	3	1	1					1	1	1	2
CO4	1	2	1	2	1							2	1	3	1	1
CO5	2	1	1	2	3			1			1		1	2	2	1
CO6	1	3	1	2	1					2	1	2	1	1	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT45	BASIC INDUSTRIAL BIOTECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem: 04** **Category:** **PC**

Prerequisites:

Aim: To develop the skills of the students in the area of important bio products and its production protocol

Course Outcomes:

After completion of this course students will be able to

CO1. Overview of historical industrial bioprocess and relate it into modern biotechnology.
CO2. Apply the knowledge on the commercial production of primary metabolites.
CO3. Outline the production of secondary metabolites with suitable examples.
CO4. Produce enzymes and other bio products applicable for both industrial and agriculture field.
CO5. Illustrate the production of modern biotechnological products.
CO6. Evaluate the modern bio products for the applications of therapeutics and medicinal purposes.

INTRODUCTION TO INDUSTRIAL BIOPROCESS **9**

A historical overview of industrial fermentation process – Traditional and modern biotechnology- A brief survey of organisms- processes- products relating to modern biotechnology- Process flow sheeting–block diagrams-pictorial representation.

PRODUCTION OF PRIMARY METABOLITES **9**

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenylalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.,)

PRODUCTION OF SECONDARY METABOLITES **9**

Study of production processes for various classes of secondary metabolites- antibiotics- beta-lactams (penicillin, cephalosporin etc.)- Aminoglycosides (streptomycin etc.,) macrolides (erythromycin)-Vitamins and steroids.

PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS **9**

Production of industrial enzymes such as proteases, amylases, lipases, cellulases etc- Production of biopesticides – Biofertilisers - Biopreservatives (Nisin)- Cheese- Biopolymers (xanthangum, PHB etc.,)-Single cell protein.

PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS **9**

Production of recombinant proteins having therapeutic and diagnostic applications- Production of vaccines - Production of monoclonal antibodies- Products of plant and animal cell culture.

Total Periods: 45

Text Books:

1. Casida Jr, L. E., "Industrial Microbiology", New Age International (P)Ltd.
2. Presscott and Dunn. "Industrial Microbiology", CBS Publishers & Distributors, 4th Edition, (2005)

References:

1. Wulf Cruger and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", Panima Publishing Corporation, 2nd Edition, (2000)
2. Murrey Moo & Young, "Comprehensive Biotechnology", Pergamon, 2nd Edition, (2011).
3. S.Y. Lee, J. Nielsen, G. Stephanopoulos, "Industrial Biotechnology", (2017).
4. Wim Soetaert, Erick publishers J. Vandamme, " Industrial Biotechnology" (2010).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	2	2	2	2				1	1	3	1	1	1
CO2	1	3	2	3	2	1							1	3	1	1
CO3	1	2	3	3	2	1	1	1			2	1	1	1	2	1
CO4	2	2	2	3	1	2	1					1	1	1	1	2
CO5	2	2	1	2	3	1	2	1			1	1	2	1	3	1
C06	1	3	1	2	1			3		1	1	2	2	2	3	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT47 ANALYTICAL METHODS IN BIOTECHNOLOGY LABORATORY **L-T-P C**

0-0-3 2

Programme: B.Tech Bio-Technology **Sem: 04 Category: PC**

Aim: To develop skills of the students in the area of microbiology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

Course Outcomes:

The students will be able to

CO1. Validate an instrumental method with high precision and accuracy.
CO2. Systematically execute an experiment
CO3. Separate different compounds by Chromatography
CO4. Learn the principles behind qualitative and quantitative estimation of biomolecules
CO5. Apply UV spectrophotometry method of analysis.
CO6. Perform different analytical techniques in analytical works

LIST OF EXPERIMENTS

1. Precision and validity in an experiment using absorption spectroscopy and Validating Lambert-Beer's law using $KMnO_4$
2. Finding the molar absorptivity and stoichiometry of the $Fe(1,10phenanthroline)_3$ Using absorption spectrometry.
3. Finding the pKa of 4-nirophenol using absorption spectroscopy.
4. UV spectra of nucleic acids.
5. Estimation of Sulphate by nephelometry.
6. Estimation of Aluminium alizarin by fluorimetry.
7. Chromatography analysis using Paper and TLC.
8. UV spectra of nucleic acids.
9. Chromatography using column.
10. UV–spectra of proteins.

Total Periods: 45

References:

1. Jeyaraman J., "Laboratory Manual in Biochemistry", New Age International Publishers, 2nd Edition, 2011

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	2	2								2	1	1	2
CO2	3	2	1	2	2								1	3	2	1
CO3	1	2	3	3	2							1	1	2	2	1
CO4	1	2	1	3	2						1	1	2	1	2	1
CO5	2	1	2	3	2			1				1	2	1	1	1
CO6	2	1	1	2			1					2	2	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT48 **CHEMICAL ENGINEERING LABORATORY** **L-T-P C**
0-0-3 2

Programme: B.Tech Bio-Technology **Sem: 04** **Category: PC**

Aim: To develop skills of the students in the area of microbiology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

Course Outcomes:

The students will be able to

CO1. Able to calculate pressure and flow rate of liquid.
CO2. Find out the efficiencies of filtration and distillation range.
CO3. Calculate the heat exchange limitation.
CO4. Separate soluble components by using liquid equilibria.
CO5. Knowledge on the basic principles of chemical engineering.
CO6. Define working principles of fluid moving machinery and transport phenomena.

LIST OF EXPERIMENTS

1. Flow measurement through annular pipe
2. Flow measurement through straight pipe
3. Pressure drop in pipes and packed columns
4. Fluidization
5. Filtration
6. Heat exchanger
7. Simple and steam distillation
8. Distillation in packed column
9. Liquid-liquid equilibria in extraction
10. Adsorption equilibrium

Total Periods: 45

References:

1. Mccabe & Smith "Unit Operations of Chemical Engineering", McGraw Hill, 7th Edition, 2014

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2		2			2		1	2	1	1	1
CO2	3	1	3	2			3					2	1	1	2	1
CO3	3	3	1	2			2			3			1	1	2	1
CO4	2	3	1	2					1				1	1	1	3
CO5	3	1	3	2			3					2	1	1	2	1
CO6	3	2	3	2		2	2	1		2	2		2	1		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS49 **FUNCTIONAL ENGLISH – II** **L-T-P** **C**

0-0-2 **-**

Programme: Common to all branches **Sem: 4 Category: EEC**

Aim: To Create an Environment to experiment communication skills with Intermediate resources

Course Outcomes:

The students will be able to,

CO1. Gain the spirit of accurate and appropriate Basic communication.
CO2. Implement the application of the different forms of advanced grammar.
CO3. Recollect words and their meaning for the specific purpose.
CO4. Develop students' accuracy in Written Communication.
CO5. Improve Communication Skills in formal and informal situations.
CO6. Sum up the key points.

UNIT I **6**

GRAMMAR: Concord and Sentence structure.
READING: Reading a passage and finding an error, reading charts, tables, graphs and making inference.
WRITING: Creative writing-paragraph and essay writing, writing memo.
LISTENING: Listening to short conversation, instructions and directions.
SPEAKING: Describing- what I enjoy about my studies, describing about the history of a company, describing various designations in the company, describing a product and how it is advertised, describing the selection process of a company.

UNIT II **6**

GRAMMAR: If clause
READING: Reading leaflet and pamphlets, reading for gathering information.
WRITING: Writing report, proposals.
LISTENING: Listening to lectures and ted talks.
SPEAKING: Mini presentation on technical topics- English for presentations- Difference between lecture speech and presentation- what makes a good presentation-planning, purpose, audience, gathering information, using av materials, gestures, and interaction ability.

UNIT III **6**

GRAMMAR: Reported speech.
READING: Reading and interpreting visual material, reading online content and reading technical reports.
WRITING: Writing product review, writing instructions and recommendations.
LISTENING: Listening to technical presentation, speeches and interviews.
SPEAKING: Group discussion, general interaction.

Total Periods: 18

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2	2		2				3	3	3	3				1
CO2	3										3	3				1
CO3	2	2		2								3			2	
CO4										3		3	1			
CO5									3	3	3	3				
CO6									3	3	3	3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT51 **BIOPROCESS PRINCIPLES** **L-T-P C**

3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 05 Category: PC**

Prerequisites:

Aim: To develop skills of the students in the area of bio process technology with emphasis on Bioprocess principles.

Course Outcomes:

After completion of this course students able to

CO1. Apply engineering principles to systems containing biological catalysts to meet the needs of the society.

CO2. Optimize the medium suitable for the production of the biological products based on the microbial growth kinetics.

CO3. Design the sterilization equipment based on the thermal death kinetics.

CO4. Interpret the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes.

CO5. Modify the biological materials to improve its usefulness by finding the optimal formulation materials to facilitate product production.

CO6. Convert the promises of molecular biology and genetic engineering into new processes to make bio products in economically feasible way.

OVERVIEW OF FERMENTATION PROCESS **9**

Overview of fermentation industry - General requirements of fermentation processes - Basic configuration of Fermenter and ancillaries - Main parameters to be monitored and controlled in fermentation processes.

AW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS **9**

Criteria for good medium - Medium requirements for fermentation processes - Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements - Medium formulation of optimal growth and product formation - Examples of simple and complex media - Design of various commercial media for industrial fermentations – Medium optimization methods

STERLIZATION KINETICS **9**

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.

METABOLIC STOCHIOMETRY AND ENERGETICS **9**

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

KINTEICS OF MICROBIAL GROWTH AND PRODUCT FERMENTATION **9**

Modes of operation - Batch, fed batch and continuous cultivation - Simple unstructured kinetic models for microbial growth - Monod model - Growth of filamentous organisms - Product formation kinetics – Leudeking -Piret models, substrate and product inhibition on cell growth and product formation.

Total Periods: 45

Text Books:

1. Shuler and Kargi., "Bioprocess Engineering", Prentice Hall, 2nd Edition. (2002).
2. Bailey, J.E. and Ollis, D.F., "Biochemical Engineering Fundamentals", McGraw Hill, 2nd Edition. (2010).

References:

1. Schugerl K., Bellgardt K.H., "Bioreaction Engineering", Springer publications, (2000).
2. Peter F. Stanbury., Stephen J. Hall & A. Whitaker., "Principles of Fermentation Technology", Science & Technology Books, (2009).
3. Pauline Doran., "Bioprocess Engineering Calculation", Blackwell Scientific Publications. (2012).
4. Harvey W. Blanch., Douglas S. Clark., "Biochemical Engineering", Marcel Dekker, Inc. (2015).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	2	1	2	3					2	2	1	2	1
CO2	3	2	1	2	2	3		1	2			1	2	1	2	2
CO3	1	2	1	2	1		2					1	1	2	3	1
CO4	2	1	2	2	1		2					1	1	1	2	2
CO5	2	2	2	1	2	1			2				1	1	2	1
CO6	1	1	2	2			2					1	2	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT52 **BIOINFORMATICS** **L-T-P C**
3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 05** **Category: PC**

Prerequisites:

Aim: This course aims to develop the skills of the students in Bioinformatics. This is a pre-requisite for certain elective courses offered in the subsequent semesters & for project work.

Course Outcomes:

After completion of this course students able to

CO1. Recognize the basic concepts of OS, Linux commands, databases and get familiarity with biological databases.
CO2. Perform different types of sequence alignments and various kinds of blast search.
CO3. Implement the concepts involved in phylogenetic analysis and structure predictions.
CO4. Apply the different machine learning techniques and its applications in biotechnology.
CO5. Acquire programming skills in Perl.
CO6. Perform various tools to study the protein modelling and implement it in drug development studies.

INTRODUCTION **9**

Basic UNIX commands–telnet–ftp–protocols–hardware–topology-search engines–search algorithms– Perl programming.

DATABASES **9**

Data management – data life cycle – database technology – interfaces and implementation–biological databases and their uses.

PATTERN MATCHING AND MACHINE LEARNING **9**

Pair wise sequence alignment–local vs. global alignment–multiple sequence alignment – dot matrix analysis – substitution matrices – dynamic programming – Bayesian Methods–tools–BLAST–FASTA–machinelearning–neuralnetworks–statisticalmethods–HiddenMarkovmodels– Homology Modeling.

PHYLOGENY **9**

Introduction; mutations; irrelevant mutations; controls; mutations as a measure of time; distances; reconstruction; distances between species; estimating time intervals from distances.

ADVANCE TOPIC IN BIOINFORMATICS **9**

Biomolecular and cellular computing–microarray analysis–systems biology.

Total Periods: 45

Text Books:

1. B. Bergeron, Bioinformatics Computing, PHI, 2002.
2. Westhead, D.R., Parish,J.H., Twyman,R.M., Instant Notes In Bioinformatics, BIOS Scientific Publishers,2000.

References:

1. C.Gibas & P.Jambeck, Developing Bioinformatics Skills, O'Reilly, 1999.
2. Arthur K.L., "Introduction to Bioinformatics", Oxford University Press, 4th Edition, 2014

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2				1				1	3	2	1	1
CO2	1	1	3	1								1	1	1	1	1
CO3	2	1	1	1		2						1	2	1	2	2
CO4	1	1	1	3		1		2				2	1	1	2	2
CO5	1	3	2	1								1	2	2	1	1
CO6	2	2	2									1	2	2	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT53 **MASS TRANSFER OPERATIONS** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 05** **Category:** **PC**

Prerequisites:

Aim: To develop skills of the students in various mass transfer operations with special emphasis on diffusion phenomenon, absorption, distillation, extraction and drying mechanisms. This serves pre-requisite in industries.

Course Outcomes:

After completion of this course students able to

CO1. Discuss the fundamental concepts of mass transfer and apply those concepts to solve real engineering problems.

CO2. Construct and analyze the simultaneous phase equilibrium and mass balances in the absorption which is involved in the various process industries.

CO3. Complete design calculations for equilibrium staged separation processes like distillation.

CO4. Learn about the solid-fluid operations like adsorption and drying and industrial equipment's.

CO5. Generalize various applications of mass transfer operations in industry and environment.

CO6. Design and construction with operating principles of process economics of separating equipment's.

DIFFUSION AND MASS TRANSFER **9**

Molecular diffusion in fluids and solids - Inter phase mass transfer; Mass transfer coefficients – Analogies in transport Phenomenon.

GAS LIQUID OPERATIONS **9**

Principles of gas absorption – Single and Multicomponent absorption – Absorption with Chemical Reaction – Design principles of absorbers – Industrial absorbers - HTU, NTU concepts.

VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria - Simple, Steam and Flash distillation – Continuous distillation – McCabe Thiele & Ponchon-Savarit principles – Industrial distillation equipments - HETP, HTU and NTU concepts.

EXTRACTION OPERATIONS **9**

L-L equilibria - Staged and continuous extraction - Solid-liquid equilibria – Leaching principles.

SOLID FLUID OPERATONS **9**

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

Total Periods: 45

Text Books:

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

References:

1. Coulson and Richardson., "Chemical Engineering", Vol.I & II, Asian Books Pvt. Ltd. (1998).
2. Dutta B.K , "Principles of Mass Transfer and Separation Proecesses" , Prentice Hall India Learning Pvt. Ltd. (2006).
3. Gavhane K.A., " Mass Transfer – II", 6th Edition , Nirali Prakashan publishers, (2009).
4. McCabe W.L., Smith J.M., "Unit operations in Chemical Engineering", 7th Edition, Tata McGraw Hill.(2017).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2		3		2				1	3	3	2	1
CO2	1	2	1	2				2		2		1	3	2	3	1
CO3	1	2	1	2						1		2	3	3	3	1
CO4	1	2	1	2				1		2		1	3	2	3	1
CO5	1	2		2								1	3	1	1	1
CO6	1	3		1								1	3	2	3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT54 **PLANT BIOTECHNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 05** **Category: PC**

Prerequisites:

Aim: To develop the skills of the students in the area of Plant Biotechnology and its application in modern world.

Course Outcomes:

After completion of this course students able to

CO1. Familiarize with genetic organization in plants and mitochondrial genome.
CO2. Apply the method of transformation and their implications.
CO3. Develop knowledge on genetic engineering and recombinant technology.
CO4. Interpret the solution for agriculture plantation and therapeutic products production.
CO5. Gain knowledge for the development of therapeutic products.
CO6. Learn knowledge about the plant tissue culture and transgenic plants.

ORGANISATION OF GENETIC MATERIAL **9**

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

CHLOROPLAST AND 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.

NITROGEN FIXATION **9**

Nitrogenase activity, nod genes, nif genes, bacteroids.

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.

APPLICATIONS OF PLANT BIOTECHNOLOGY **9**

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

Total Periods: 45

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.

References:

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

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	2	1							2	1	2	1
CO2	1	1	3	2	2			1				2	1	1	2	1
CO3	2	2	3	2	1	1					2	1	1	2	3	1
CO4	1	2	2	3								1	1	1	1	2
CO5	3	2	2	2									1	1	2	1
CO6	3	3	1	2		1					1	1	2	1	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT55 **PROTEIN ENGINEERING** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 05** **Category:** **PC**

Prerequisites:

Aim: This course aims to deliver students a wide knowledge about structure, basic working, activity of various proteins and their role in the field of biotechnology.

Course Outcomes:

After completion of this course students able to

CO1. Describe the organization of protein structure.
CO2. Identify various chemical interactions that stabilize protein structure.
CO3. Learn the interactions in the protein core important for stability.
CO4. Inspect topology diagram of protein secondary structures.
CO5. Analyze various data to determine the binding affinity.
CO6. Design principles and database analysis

AMINO ACID AND THEIR CHARACTERISTICS **9**

Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa) - Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups) - Peptide synthesis

BONDS AND ENERGIES IN PROTEIN MAKEUP **9**

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure - Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure.

PROTEIN ARCHITECTURE **9**

Primary structure : Peptide mapping, Peptide sequencing – Automated Edman method & Mass-spec. High-throughput protein sequencing setup – 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 – Topology diagrams, up and down & TIM barrel structures – Tertiary structure : Domains, folding, Denaturation and renaturation - Quaternary structure : Modular nature, formation of complexes.

STRUCTURE AND FUNCTIONAL RELATIONSHIP **9**

DNA-binding proteins : Prokaryotic transcription factors - Helix-turn-Helix motif in DNA binding, Trp repressor, Eucaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeo domain - Leucine zippers, Membrane proteins : General characteristics, Trans- membrane segments, prediction, Bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins : IgG Light chain and heavy chain architecture - Abzymes and Enzymes : Serine proteases - Understanding catalytic design by engineering Trypsin, Chymotrypsin and Elastase - Substrate – assisted catalysis - Other commercial applications.

PROTEIN ENGINEERING **9**

Advantages and purpose - Overview of methods - Underlying principles with specific examples : Thermal stability T4-Lysozyme – Recombinant insulin to reduce aggregation and inactivation -,Denovo protein design.

Total Periods: 45

Text Books:

1. Branden C. and Tooze J., “Introduction to Protein Structured, 2nd Edition”, Garland Pub., NY, 1999.
2. Voet D. and Voet G., “Biochemistry”,Third Edition, John Wiley and Sons. (2001).

References:

1. Moody P.C.E.and Wilkinson A.J., “Protein Engineering”, IRLPress, Oxford, UK. (1990).
2. Creighton T.E., “Proteins”, Freeman W H, Second Edition. (1993).
3. Mallorie N. Sheehan., “Protein Engineering – Design, Selection and Applications”, Nova Science Publishers, UK Edition. (2013).
4. Kurra Venkata Gopaiah., “ Protein Engineering”, Random Publications, 1st Edition. (2017)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1		3		2				1	3	3	2	1
CO2	1	2	1	2				2		2		1	3	2	3	1
CO3	1	2	2	2						1		1	3	3	3	1
CO4	1	2	2	2				1		2		2	3	2	3	1
CO5	1	2	3	2									3	1	2	1
CO6	1	3	2	2						1		2	3	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT56 **BIOETHICS** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** 5 **Category:** **PC**

Prerequisites:

Aim: This course aims to deliver students a wide knowledge about bioethics and its need in biological system

Course Outcomes:

After completion of this course students able to

CO1: Recall the basic ethics in various disciplines of biotechnology and health care.

CO2: Gain knowledge about the different types of patents and copyrights.

CO3: Describe the knowledge in stem cell technology and human resource project.

CO4: Acquire knowledge in basic techniques in transplantation.

CO5: Emphasize IPR issues and need for knowledge in patents in biotechnology.

CO6: Comprehend benefits of GM technology and related issues.

OVERVIEW OF ETHICS IN BIOTECHNOLOGY **9**

Brief history and origin of bioethics, philosophical reflections on experimenting with human subjects, advantageous and disadvantages of biotechnology in developing counties and case studies.

INTELLECTUAL PROPERTY RIGHTS **9**

Implications of IPRs and Agricultural Technology, role of WTO, General Agreement on Tariffs and Trade (GATT), Patenting and the procedures involved in the application for grading of a patent. Bioethics in biodiversity, Ethics of Resource Management, Impact of GM Crops and GM Foods.

HUMAN GENOME PROJECT **9**

The human genome project diversity, strategies and ethical issues. Foetal sex determination and abortion, ethical issues related to genomic studies

STEM CELL RESEARCH **9**

Application and ethics involved in stem cells research, animal cloning and animal experiments, ethics in human cloning, Psychological aspect of infertility and ethics of invitro fertilization.

ORGAN TRANSPLANTATION IN HUMAN BEINGS AND MEDICAL CARE **9**

Ethics in Xenotransplantation and transgenesis, medical ethics, CCAC Guidelines on Transgenic Animals and animal welfare, the need of ethical review.

Total Periods: 45

Text Books:

1. Sree Krishna V. Bioethics and Biosafety in Biotechnology, The New Age International P. Ltd. Publishers, 2007.

References:

1. Nancy S. Jecker, Albert R. Jonsen, Robert A, Bioethics, second edition, Pearlman.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	1			1		1	1		2	1	1	2	2
CO2	1	2	2	2			1		1	1		1	2		1	1
CO3	2	1	2	1	3	2	1	2	1	1	1	3	2	2	1	2
CO4	1	2	1	2	3		1		1			2	1	3	1	2
CO5	2	1	1	2	3		1		1	1		1	1	2	1	1
CO6	2	1	2	1	1		1	1	1	1		2	1	3	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT57 MOLECULAR BIOLOGY LABORATORY L-T-P C
0-0-3 2

Programme: B.Tech Bio-Technology **Sem: 05 Category: PC**

Aim: To develop skills of the students in the area of molecular biology particularly to identify microbes, their structure, their metabolism and their industrial applications. This will be a prerequisite for all courses offered in Bioprocess Technology.

Course Outcomes:

The students will be able to Students able to

CO1. Demonstrate safe laboratory practices and equipment handling.
CO2. Isolate nucleic acids from biological samples.
CO3. Estimate the quantity and quality of nucleic acids using Gel Electrophoresis and Spectrophotometer.
CO4. Determine the molecular weight of given nucleic acid fragment.
CO5. Demonstrate the manual sequencing of nucleic acids.
CO6. Analyze hazardous chemicals and safety precautions in case of emergency

LIST OF EXPERIMENTS

1. Genomic DNA isolation from *E.coli*
2. Isolation of Plant cell genomic DNA.
3. Isolation of genomic DNA from animal cells.
4. Total RNA isolation from bacterial cells.
5. Evaluation of isolated plasmid by Agarose Gel Electrophoresis.
6. Restriction enzyme digestion.
7. Competent cells preparation and Blue and white selection for recombinants.
8. Plating of λ phage.
9. Lambda phage lysis of liquid culture.
10. SDS PAGE

Total Periods: 45

References:

1. Denny R. Randall., "Molecular Biology Laboratory Manual", MERLOT Publication. (2016)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	1		2	2	3		3		2	3	3	2	1
CO2	2	3	1	3	2								3	2	3	1
CO3	1	3	1	3	2							1	3	3	3	1
CO4	2	3	1	2								2	3	2	3	1
CO5	2	3	1	2	3							2	3	1	1	1
CO6	2	3	1	1								2	3	1	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT58 **BIOINFORMATICS LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem: 05** **Category: PC**

Aim: To develop the skills of the students in the area of bioinformatics by using various tools and softwares

Course Outcomes:

The students will be able to Students able to

CO1. Recognize the basic concepts of OS, databases and get familiarity with biological databases.
CO2. Perform different types of sequence alignments and various kinds of blast search.
CO3. Interpret phylogenetic analysis and structure predictions.
CO4. Compare different machine learning techniques and its applications in biotechnology.
CO5. Apply Perl programming to develop bioinformatics tools.
CO6. Develop computational based solutions for biological perspectives.

LIST OF EXPERIMENTS

1. Introduction to UNIX basic commands and UNIX Filters.
2. Perl programming and applications to Bioinformatics.
    a. Basic scripting.
    b. Regular expressions.
    c. File i/o & control statement.
    d. Subroutines & functions.
    e. Writing scripts for automation.
3. Types of Biological Databases and Using it.
    a. Genbank.
    b. Protein Data Bank.
    c. Uniprot.
4. Sequence Analysis Tools
    a. Use of BLAST, FASTA (Nucleic Acids & Protiens).
    b. Use of ClustalW.
    c. Use of EMBOSS.
5. Phylogenetic Analysis
    a. Use of Phyllip.
6. Molecular Modeling
    a. Homology Modeling–Swiss modeller.
    b. Any Open Source Software.

Total Periods: 45

References:

1. Arthur K.L., “Introduction to Bioinformatics”, Oxford University Press, 4th Edition, 2014

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	1	2		1		1		1	3	2	1	1
CO2	1	1	3	1	2	1				1		1	2	1	1	1
CO3	2	1	1	1	1	2						1	2	1	2	1
CO4	1	1	1	3		1		2				2	1	1	1	2
CO5	2	1	2			2				1		1	1	1	2	1
CO6	1	1	1	2		2		2				2	1	1	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS59 **CAREER ENGLISH (Preliminary)** **L-T-P** **0-0-2** **C** **-**

Programme: Common to all branches **Sem** **5** **Category:** **EEC**

Aim: To Improve learner's Communication Skills in English

Course Outcomes:

The students will be able to

CO1. Train the students in Language Skills, Soft Skills, Inter Personal Skills, Decision Making and Business Communication.

CO2. Competent in Presentation skill.

CO3. Imbibe the knowledge of effective classroom speaking and presentation.

CO4. Provide opportunities to learners to practice their communicative skills to become proficient users of English.

CO5. Write job applications.

CO6. Enhance their writing skill by undergoing frequent practice.

UNIT I **6**

Elements of effective presentation – Structure of presentation – Presentation tools – Voice Modulation – Audience analysis – Body language – Video samples.

UNIT II **6**

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity – Stress Management & Poise – Video Samples.

UNIT III **6**

Covering letter – strategies to write, resume and it's various kinds.

Total Periods: **18**

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2	2						3	3	3	3				3
CO2										3		2				2
CO3					2				2	3		2				
CO4									2	3		2			1	
CO5								3		3						
CO6			2								2				1	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT61 **CHEMICAL REACTION ENGINEERING** **L-T-P** **C**

3-1-0 **4**

Programme: B. Tech Bio-Technology **Sem: 06** **Category:** **PC**

Prerequisites:

Aim: This course aims to develop the skills of the students in the area of chemical reaction engineering. This is a pre-requisite for courses offer in Bioprocess Technology and for designing a reactor.

Course Outcomes:

After completion of this course students able to

CO1. Apply the fundamentals and basic concepts of chemical kinetics.
CO2. Develop knowledge on various reactions involving in the reactor designs.
CO3. Illustrate the reactor performance with ideal and non-ideal flow.
CO4. Analyze the resistances and developing the catalytic reactions.
CO5. Compare the mechanism of various industrial reactors.
CO6. Design the reactor performance with different phases.

SCOPE OF CHEMICAL KINETICS AND CHEMICAL REACTION ENGINEERING **12**

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

IDEAL REACTORS **12**

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

IDEAL AND NON IDEAL FLOW **12**

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

GAS SOLID, GAS LIQUID REACTIONS **12**

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

FIXED BED AND FLUID BED REACTORS **12**

G/l reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; Reactors for fluid-fluid reactions; tank reactors.

Total Periods: 60

Text Books:

1. Levenspiel O. "Chemical Reaction Engineering", 3rd Edition. JohnWiley.1999.
2. Fogler H.S. "Elements of Chemical Reaction Engineering", Prentice Hall India.2002.

References:

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

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2			1		2	1		1	2	1	3	2
CO2	2	3	2	3			1		2	2		1	3	2	1	1
CO3	3	2	1	3	3		1	2	2	2	1	1	3	2	1	1
CO4	3	3	2	3	3		1			2		1	2	3	1	1
CO5	3	3	2	3	3	2	2			2		1	3	3	3	1
CO6	2	3	2	1	1		2	1	2	1		2	3	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT62 **IMMUNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **06** **Category:** **PC**

Prerequisites:

Aim: This course aims to develop the skills of the students in Immunotechnology, Proteomics and genomics etc.,

Course Outcomes:

After completion of this course students able to

CO1. Acknowledge the various types of cells and organs involved in immune system.

CO2. Illustrate the cellular responses of T- Cells, B Cells and other immune response cells.

CO3. Apply the concepts of immunology in vaccine development and treatment of infectious diseases.

CO4. Perform the concept of immune response in Transplantation and Tumour immunology.

CO5. Analyze the various development of autoimmune disorders and treatment of infection disease.

CO6. Improve the overall concepts of immune response that helps to implement in animal studies.

INTRODUCTION **9**

Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; Antigens-chemical and molecular nature; Haptens; adjuvants; types of immune responses; theory of clonal selection.

CELLULAR RESPONSES **9**

Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions; monoclonal antibodies: principles and applications; antigen presenting cells; major histocompatibility complex; antigen processing and presentation; regulation of T-cell and B-cell responses.

INFECTION AND IMMUNITY **9**

Injury and inflammation; immune responses to infections: immunity to viruses, bacteria, fungi and parasites; cytokines; complement; immunosuppression, tolerance; Hypersensitivity; AIDS and Immuno-deficiencies; resistance and immunization; Vaccines.

TRANSPLANTATION AND TUMOUR IMMUNOLOGY **9**

Transplantation: genetics of transplantation; laws of transplantation, Mechanism and clinical manifestation of Graft rejection, Tumor immunology.

AUTOIMMUNITY **9**

Autoimmunity, Organ specific and Systemic autoimmune Disorders, Diagnosis and Treatment.

Total Periods: 45

Text Books:

1. Roitt I, Male, Brostoff, Immunology, Mosby Publ., 2002
2. Kuby J, Immunology, WH Freeman &Co., 2000.

References:

1. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 1998.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	2	1						3	2	1	1	1
CO2	1	1	3	2	2			1				2	1	1	2	2
CO3	2	2	3	2	1	1					2	1	1	2	3	1
CO4	1	2	2	3								1	1	2	1	2
CO5	1	2	2	2	3						1	1	2	2	1	1
CO6	1	2	2	3	1	2		3				2	1	1	3	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT63 **GENETIC ENGINEERING** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 06** **Category: PC**

Prerequisites:

Aim: To develop the skills of the students in Immunotechnology, Proteomics and genomics etc.

Course Outcomes:

After completion of this course students able to

CO1. Gain knowledge of interest and parameters to be considered while designing a cloning strategy.

CO2. Demonstrate variety of screening techniques to characterize the clones.

CO3. Apply PCR in cloning, diagnosis and mutant generation including the development of high value products

CO4. Describe DNA technology within the constraints of environmental and ethical consequence of practicing Genetic engineering

CO5. Exploit the benefits of transgenic for societal applications.

CO6. Apply the concept of Genetic Engineering in Biological fields with its ethics.

BASICS OF RECOMBINANT DNA TECHNOLOGY **9**

Role of genes within cells, genetic elements that control gene expression, restriction and modifying enzymes, safety guidelines of recombinant DNA research.

CREATION OF RECOMBINANT MOLECULES **9**

Restriction mapping, linkers and adaptors, Characteristics of plasmid and phage vectors, Types – pBR322, selectable markers, cosmids, Phagemids, Artificial chromosomes - BAC, PAC.

CONSTRUCTION OF LIBRARIES **9**

Construction of cDNA and genomic libraries, Blotting Techniques: Southern, Northern and Western

POLYMERASE CHAIN REACTION **9**

PCR: Basic principle, Applications, Types- Nested PCR, Inverse PCR, RACEPCR. Molecular beacons, RFLP, RAPD and Site directed mutagenesis. Nucleic acid sequencing: Sanger's method of DNA sequencing.

APPLICATION OF RECOMBINANT DNA TECHNOLOGY **9**

Genetic Transformation inplants, Ti plasmid and Agrobacterium mediated transformation, transgenic and knockout animals.

Total Periods: 45

Text Books:

1. Primrose SB and R. Twyman "Principles of Gene Manipulation & Genomics Blackwell Science Publications, (2006).
2. Gon Grierson "plant Genetic Engineering", Blackie academic & professional, (2013).

References:

1. Berger Sl., Kimmer A R., "MethodsInEnzymology",Vol.152, Academic Press, (1987).
2. Ansubel FM., Brent R., KingstonR E., Moore DD., "Current Protocols in Molecular Biology", Greene Publishing Associates, NY (1988).
3. Lisa yount, "Biotechnology and Genetic Engineering" Edition 3, facts on file, (2008).
4. Harry Levine, "Genetic Engineering", (2006).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1			1	1		1		2	1	1	2	2
CO2	1	2	1	2			1	2				1	2	3	1	1
CO3	1	2	1	1	3		1	2			1	3	1	2	3	1
CO4	1	1	1	1	3		1	2			2	2	2	3	1	1
CO5	1	1	1	1	2		1	2		1	2	1	1	1	1	1
CO6	1	2	1	1	2	2		3	1	1	2		3	3	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS61 ENGINEERING ECONOMICS AND MANAGEMENT L-T-P C
3-0-0 3

Programme: B. Tech Bio-Technology **Sem: 06 Category: PC**

Course Outcomes: After completion of this course students able to

CO1. Explain about the fundamentals of economic concepts.
CO2. Describe the concept of theory of production and Human resource management.
CO3. Demonstrate the Management Principles, functions of management & organizational structures.
CO4. Adjust inflation and solve different types of replacement problems.
CO5. Prepare internal rate of return, payback period, net present value and cost benefit analysis.
CO6. Prepare feasibility reports and break even analysis.

FUNDAMENTALS OF ECONOMICS **9**

Concept and scope of engineering economics - basic concepts of goods, utility, value and wealth - relation between economic decision and technical decision - Law of demand & supply – factors influencing demand - elasticity of demand – demand forecasting - Basic economic problems - causes, types and measures to control Poverty, Un employment and Inflation.

THEORY OF PRODUCTION **9**

Theory of production; production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur) - Law of variable proportions & law of returns to scale - Introduction to Human Resource Management; definitions, objectives of manpower planning, process, sources of recruitment, process of selection - Corporate Social Responsibility; meaning, importance - Business Ethics; meaning, importance.

FUNCTIONS OF MANAGEMENT **9**

Introduction to Management & administration, skill, types and roles of managers – Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory – Functions of Management – Planning, Organizing, Staffing, Directing, Controlling – Organizational Structures; meaning, principles of organization, types (explanation with merits and demerits), span of control, departmentalization.

DEPRICATION AND REPLACEMENT ANALYSIS **9**

Depreciation – various methods of depreciations – inflation adjusted decisions – procedure to adjust inflation – Types of maintenance – types of replacement problem - determination of economic life of an asset – replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender.

COST ANALYSIS **9**

Types of costing – traditional costing approach – activity base costing – cost output relationship in the short run and in long run – types of pricing and its practice – appraising project profitability – internal rate of return – payback period – net present value – cost benefit analysis –feasibility reports-break even analysis - managerial uses of breakeven analysis.

Total Periods: 45

Text Books:

1. Dewett K.K. & Varma J.D., "Elementary Economic Theory", S Chand & Co., 2006.
2. Suma Damodaran, "Managerial economics", Oxford University press 2006.

References:

1. Sharma, K.K, "Principle of Economics", Abishek publications,2002.
2. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

Course Outcomes	Program Outcomes (POs)												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2		1		2					2	1			2	
CO2			1	2				2					1			
CO3	1		2		2									2		
CO4		1			3		2									2
CO5	2			1		2		1							1	
CO6	3		1	2	1				2					2		

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT67 **GENETIC ENGINEERING LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem: 06** **Category: PC**

Aim: To develop the skills of the students in the area of important bio products and its production protocol.

Course Outcomes:

The students will be able to

CO1. Learn about cloning of genes, how to express them for protein production.
CO2. Apply genetic engineering tools to produce products beneficial in agriculture and healthcare.
CO3. Interpret the ethical and biosafety issues and consequences while performing experiments in the laboratory.
CO4. Familiarize the importance of PCR in cloning, diagnosis and mutant generation.
CO5. Compare the significance and power of recombinant DNA technology and ethical consequences.
CO6. Estimate the quantity and quality of nucleic acids, proteins using gel electrophoresis.

LIST OF EXPERIMENTS

1. Preparation of plasmid DNA.
2. Elution of DNA from agarose gels.
3. Ligation of DNA into expression vectors.
4. Transformation.
5. Optimisation of inducer concentration for recombinant protein expression.
6. Optimisation of time of inducer for recombinant protein expression.
7. SDS-PAGE, 2DGel, ISO–electric Focussing.
8. Western blotting.
9. Hybridisation with anti-sera.
10. PCR.

Total Periods: 45

References:

1. Frederick M.A., Roger B., Robert E. K.,, David D. M.,, Seidman J.G., John A.S., Kevin S., “Short protocols in molecular biology- Volume I &II”, Wiley & sons, 1st Edition, 2002

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1	2			1			1	2	1	2	3	1
CO2	2	3	2	2				1			1	1	1	1	3	1
CO3	1	3	1	1	2			1	3		1	3	1	1	3	1
CO4	1	1	1	1			1	1				1	1	1	2	1
CO5	1	2	2	1	2			1	1			1	1	1	1	1
CO6	1	3	1	3	2		1					2	3	3	3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT68 **IMMUNOLOGY LABORATORY** **L-T-P** **C**

0-0-3 **2**

Programme: B.Tech Bio-Technology **Sem:** **06** **Category:** **PC**

Aim:

Course Outcomes:

The students will be able to

CO1. Handle animals for immunological experiments.
CO2. Design and perform diagnostics tests like identification of blood cells, ELISA and Electrophoresis.
CO3. Determine the toxicity of the natural and commercially available drugs.
CO4. Apply principles of safety, quality assurance and quality control in Immunology.
CO5. Assess the Immunoassay to understand complement fixation system and other diseased conditions.
CO6. Correlate the immunological disorders and the factors involved in it by various immunological assays.

LIST OF EXPERIMENTS

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood group.
4. Immunodiffusion.
5. Immunoelectrophoresis.
6. Testing for typhoid antigens by Widal test.
7. Enzyme Linked Immunosorbent Assay(ELISA).
8. Isolation of peripheral blood mononuclear cells.
9. Isolation of monocytes from blood.
10. Immunofluorescence.

Total Periods: 45

References:

1. Roitt I., Brostoff M., "Immunology", Mosby Publication, 5th Edition, 2002.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	2	1			1			1	2	2	1	1
CO2	1	1	3	2	2			1				2	1	1	1	1
CO3	2	2	3	2	1	1					2	1	1	1	3	1
CO4	2	2	3	2	1	1					2	1	1	1	3	1
CO5	1	2	1	3		1					1	1	2	1	1	1
CO6	1	1	1	2		1		1				1	1	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161HS69	**CAREER ENGLISH – II**			**L-T-P**	**C**
				0-0-2	**-**
Programme:	Common to all branches	**Sem**	**6**	**Category:**	**EEC**

Aim: To practice English for Enhancing Employability skills

Course Outcomes:

The students will be able to,

CO1. Enlarge the student's aptitude and reasoning skills.

CO2. Acquire knowledge about the various principles of communication, understand its various stages and the role of audience and purpose, deal with the barriers that affect communication in a professional set up.

CO3. Practice English for Enhancing Employability skills.

CO4. Develop students job prospects through oral communication.

CO5. Enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

CO6. Enlarge the student's aptitude and reasoning skills.

UNIT I **6**

Verbal analogy, verbal reasoning, error spotting, sentence completion.

UNIT II **6**

Why is GD part of selection process? – Structure of GD – Moderator – Strategies in GD – Team work – Body Language – Mock GD – Video samples.

UNIT III **6**

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews – Video samples.

1. Resume / Report Preparation.
2. Presentation Skills: Students make presentations on given topics. (8)
3. Group Discussion: Students participate in group discussions. (6)
4. Interview Skills: Students participate in Mock Interviews. (8)

Total Periods: 18

Course Outcomes	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2			1			1		3		3	2				2
CO2			1				1		3		3	2			1	
CO3		1					1		2		2	2				1
CO4					1											
CO5									3				1			
CO6	2						1	1	3		3	2				2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT71 **BIOPROCESS ENGINEERING** **L-T-P** **C**
3-0-0 **4**

Programme: B. Tech Bio-Technology **Sem: 07** **Category:** **PC**

Prerequisites:

Aim: This course aims to develop the skills of the students in the area of Bioprocess Engineering. This will be a pre-requisite for a few elective courses and for project in Bioprocess Technology.

Course Outcomes:

After completion of this course students will be able to

CO1. Build reactor design, operation and required modifications to meet production target.
CO2. Scale up the reactors based on power, oxygen transfers and mixing time.
CO3. Analyze the impact of mass transfer resistances in immobilized enzymes and appreciate their significance in design of immobilized enzymes based reactors.
CO4. Acquire knowledge about the modeling and simulation concepts in bioprocessing.
CO5. Perform different cultivation systems for recombinant cells.
CO6. Apply imparted knowledge in biomolecules production.

ANALYSIS OF STR **12**

Stirred tank reactor - non-ideality, RTD and stability analysis, tanks in series and dispersion models– application to design of continuous sterilizer.

ANALYSIS OF OTHER CONFIGURATIONS **12**

Packed bed reactor, airlift reactor, fluidized bed reactor bubble column reactors–non- ideality, RTD and stability analysis.

BIOREACTOR SCALE UP **12**

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.

MODELLING AND SIMULATION OF BIOPROCESS **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.

BIOREACTOR CONSIDERATIONS IN ENZYME SYSTEMS **12**

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimension less groups and calculation of effectiveness factors. Design of immobilized enzyme reactors–packed bed, fluidized bed and membrane reactors.

Total Periods: 60

Text Books:

1. Shuler and Kargi, Bioprocess Engineering, Prentice Hall, 2001.
2. Pauline D., "Bioprocess Engineering Principles", Elsevier, 2nd Edition, 2012.

References:

1. Blanch H. W., Clark S. D., "Biochemical Engineering", Taylor & Francis, 2nd Edition, 1997
2. EMT.EL-Mansi. CFA. Bryce, A.L. Demain, AR. Allman: Fermentation Microbiology and Biotechnology, Second Edition 2007.
3. Bailey, J.E., Ollis, D.F., "Biochemical Engineering Fundamentals", McGraw Hill, 2nd Edition, 2010.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3						2		1	2	2	2	1
CO2	3	3	2	3						2			2	2	1	3
CO3	3	3	2	2			2	1		2		1	2	1	2	1
CO4	1	2	1	1			2		1	3		2	3	3	1	1
CO5	1	2	2	1	2							1	1	2	1	1
CO6	1	2	1	1		1	1			1	2	1	1	2	1	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT72	DOWNSTREAM PROCESSING	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** 07 **Category:** PC

Prerequisites:

Aim: Aims to explore students in the field of downstream processing and its application in product recovery.

Course Outcomes:

After completion of this course students will be able to

CO1. Select suitable bio separation process considering the physicochemical and biochemical properties of biological products.
CO2. Design strategy for isolation and purification of intracellular bio products.
CO3. Incorporate the chemical basis of various isolation methods considering the biomolecule characteristics and stability.
CO4. Design strategy for purification of bio products for process industries considering the process economics.
CO5. Perform quality control and quality assurance involved in production and marketing of bio products considering their end applications.
CO6. Design recovery outline in polishing crystallization and drying methods of a product employing.

DOWNSTREAM PROCESSING **9**

Introduction to downstream processing- Principles characteristics of biomolecules and bioprocesses- Cell disruption for product release–mechanical, enzymatic and chemical methods- Pretreatment and stabilization of bioproducts.

PHYSICAL METHODS OF SEPERATION **9**

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

ISOLATION OF PRODUCTS **9**

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

PRODUCT PURIFICATION **9**

Chromatography–principles, instruments and practice, adsorption, reverse phase-Ion- exchange Size exclusion- Hydrophobic interaction-Bioaffinity and pseudo affinity chromatographic techniques.

FINAL PRODUCT FORMULATION AND FINISHING OPERATION **9**

Crystallization- Drying and lyophilization in final product formulation

Total Periods: 45

Text Books:

1. P.A. Belter, E.L. Cussler and Wei-Houhu; Bioseparations-Downstream processing for biotechnology, Wiley interscience pub. (1988).
2. R.O. Jenkins.,(Ed.)–Product Recovery In Bioprocess Technology– Biotechnology By Open Learning Series, Butterworth-Heinemann

References:

1. J.C. Janson and L. Ryden (Ed.)–Protein Purification–Principles, High Resolution Methods and Applications, VCH Publications 1989.
2. R.K. Scopes–Protein Purification–Principles and Practice, Narosa Publications (1994).
3. Roger. G. Harrison, Paul Todd, Scott R.Rudge and Demetri P.Petrides,
4. Bio seperation Science and Engineering, Oxford University Press, Newyork, (2003).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1		2						1	1	2	2	1
CO2	1	2	1	2					3				1	2	1	1
CO3	1	1	2	1	3							3	1	2	2	1
CO4	1	2	1	1	2					2		1	2	2	1	1
CO5	1	2	2	1								1	1	2	2	2
CO6	2	1	1	2								1	1	1	2	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT73 **GENOMICS AND PROTEOMICS** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem: 07** **Category:** **PC**

Prerequisites:

Aim: This course aims to develop the skills of the students in Proteomics and Genomics. This is a prerequisite for certain elective courses offered in the subsequent semesters &for project work.

Course Outcomes:

After completion of this course students will be able to

CO1: Infer the basic concepts of genomics, transcriptomic and proteomics.

CO2: Knowledge of the major web-resources and the notion about how the methods are applied in real-life scientific research.

CO3: Understand how to perform simple analysis of this data.

CO4: Describe the different types of genome variation and their relationship to human diseases.

CO5: Define biological systems information relating to genes, proteins and cellular structures can be used to model living cells, and even to create new synthetic cells.

CO6: Implement techniques and database search to analyse complex protein samples.

INTRODUCTION **9**

Overview of Genomes of Bacteria, Archae and Eukaryota.

PHYSICAL MAPPING TECHNIQUES **9**

Top down and bottom up approach; linking and jumping of clones; genome sequencing: placing small fragments on map: STS assembly; gap closure; pooling strategies; cytogenetic mapping techniques.

FUNCTIONAL GENOMICS **9**

Gene finding; annotation ; ORF and functional predication; Subtractive DNA library screening; differential display and representational difference analysis; SAGE;TOG.

PROTEOMICS TECHNIQUES **9**

Protein level estimation; Edman protein micro sequencing; protein cleavage; 2 D gel electrophoresis; metabolic labeling; detection of proteins on SDS gels; pattern analysis; Mass spectrometry – principles of MALDI-TOF; tandem MS-MS; Peptide mass fingerprinting.

STRUCTURE FUNCTION OF RELATIONSHIP OF PROTEINS **9**

Post translation modification; protein –protein interactions; glycoprotein analysis; phosphor protein analysis, NMR and Crystallography of protein of elucidate protein structure, protein structure by modally.

Total Periods: 45

Text Books:

1. Cantor,C.R and Smith, C.L "Geneomics", John Wiley & Sons,1999.
2. Pennington,S.R. and Dunn, M.J."Proteomics: from Protein Sequence to Function", viva books publishers, 2002.

References:

1. Liebler, D.L. "Introduction to Proteomics: Tools for the new Biology", Humana press, 2002.
2. Hunt , S.P. and Livesey, F.L. " functional genomics ", Oxford university Press, 2000.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	1								1	3	1	2	1
CO2	1	1	1	2								1	1	1	2	1
CO3	3	1	1	2	2			1				3	1	2	1	1
CO4	1	1	2	1	3						3	1	1	1	3	1
CO5	1	2	2	1	1		3					1	1	1	1	1
CO6	2	1	1	1	1							1	2	1	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT74	NANO BIOTECHNOLOGY	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem: 07 Category: PC**

Prerequisites:

Aim: To develop the skills of the students in the area of Nano biotechnology and its applications.

Course Outcomes:

After completion of this course students will be able to

CO1: Understand the basic concepts in nanotechnology and system assembly.

CO2: Learn about the structure and synthesis of macromolecules.

CO3: Learn about the different microscopy equpiments and their working.

CO4: Apply the applications of nano biology in different fields.

CO5: Demonstrate the use of nanotechnology in diagnostic biology.

CO6: Learn about the health and environmental impacts of nanotechnology.

BASICS OF NANO BIOTECHNOLOGY AND SELF ASSEMBLY SYSTEMS 9

Introduction to nano biology, nano biotechnology, molecular nanotechnology; Benefits of molecular nanotechnology; Nano dendrimers; Buckyball and nanotube; Self-assembly of biomolecules - Van der Waal forces, hydrogen bonding, models, synthesis and measurement; Molecular assembly and applications.

STRUCTURE OF BIOLOGICAL MACRO MOLECULE 9

Principles of protein structure; Principles of DNA structure; Sequence/Structure relationships of DNA; Structural motifs; Introduction to in-silico prediction of 3D-structure and structure/function relationships, examples.

PATTERNING OF BIOMOLECULES AND OTHER BIOLOGICAL SUBSTANCES 9

Necessity of patterning of biomolecules and other biological substances on surfaces; Chemical/ physical binding of biomolecules on surfaces. Patterning methods-micro spotting, mechanical methods, dip-pen lithography, micro contact printing methods (soft lithography related methods); Other emerging methodologies; Potential applications and comparison of patterning methods.

MICROSCOPY FOR NANO SCIENCE 9

Basic principles and applications of Scanning probe microscopy (SPM), Scanning tunneling microscopy, Atomic force microscopy (AFM), Scanning optical probe microscopy (SOPM), Confocal FRET, SEM, TEM in nanotechnology.

APPLICATION OF NANOBIOTECHNOLOGY 9

Application of nanobiotechnology in Medicine - pharmaceutical applications, Drug delivery, tissue repair and implantation; Environment, Agriculture; Molecular electronics; Nano-Bio Devices & Systems.

Total Periods: 45

Text Books:

1. Pradeep .T., "NANO: The Essentials Understanding Nanoscince and Nanotechnology", McGraw–Hill Education (India) Ltd, 2007

References:

1. Ratner,M. Ratener, D. "Nanotechnology A Gentle Introduction to the Next Big Idea", Prentice Hall, 2003

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	1								1	3	2	2	1
CO2	1	1	2	2								1	1	1	2	1
CO3	3	2	1	2				1				3	1	2	1	1
CO4	1	2	2	1	3							1	1	1	3	1
CO5	1	2	2	1	2		1				3	1	2	2	3	1
CO6	1	2	2	1		2			1			2	1	2	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT77	BIOPROCESS LABORATORY			L-T-P	C
				0-0-3	2
Programme:	B.Tech Bio-Technology	**Sem:**	**07**	**Category:**	**PC**
Aim:					

Course Outcomes:

The students will be able to Students able to

CO1. Understand the mechanism and kinetics of the enzyme reaction.
CO2. Formulate the medium and optimization for their role in economy of the process.
CO3. Determine the growth kinetics of bacteria
CO4. Estimate the mass transfer coefficient with different methods
CO5. Design the bioreactor model.
CO6. Analyze the enzyme kinetics-Michaelis Menton parameters and immobilization

LIST OF EXPERIMENTS

1. Thermal death kinetics.
2. Batch sterilization design.
3. Batch cultivation, estimation of K_La – dynamic gassing method, exhaust gas analysis–carbon balancing, gas balancing.
4. Batch and Fed batch cultivation, exhaust gas analysis–carbon balancing, gas balancing.
5. Total cell retention cultivation, exhaust gas analysis – carbon balancing, gas balancing.
6. Estimation of K_La –sulphite oxidation method.
7. Estimation of K_La –power correlation method.
8. Residence time distribution.
9. Estimation of overall heat transfer coefficient.
10. Continuous cultivation–x-diagram, pulse and shift method, evaluation of kinetic parameters, exhaust gas analysis–carbon balancing, gas balancing.
11. Enzyme kinetics– Micheles Menton parameters.
12. Enzyme immobilization–gel entrapment & cross linking methods.

Total Periods: 45

References:

1. Stanbury, P.F., Stephen J.H., Whitaker A., "Principles of Fermentation Technology", Elsevier, 2nd Edition., 2009

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1	2					1		2	1	2	3	1
CO2	2	3	1	2								1	1	1	2	1
CO3	1	3	2	1	2				3			3	2	1	3	1
CO4	1	2	1	1			1						1	1	3	1
CO5	1	2	2	1	2	1							1	2	1	1
CO6	1	2	2	1	1			1					1	2	3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT78 DOWNSTREAM PROCESSING LABORATORY L-T-P C
0-0-3 2

Programme: B.Tech Bio-Technology **Sem: 07 Category: PC**

Aim:

Course Outcomes:

The students will be able to

CO1. Apply the lab scale techniques in large scale operations considering complexity involved in scale up process.

CO2. Design and carry out experiments while taking into account product stability, biosafety, accuracy of results and time duration.

CO3. Appreciate the complexity of products of biological origin and design strategy accordingly to purify them.

CO4. Learn the techniques of products purification.

CO5. Carry out experiments in product formulation and finishing.

CO6. Acquired knowledge for the separation of whole cells and other ingredients from the culture broth.

LIST OF EXPERIMENTS

1. Solid liquid separation–centrifugation, microfiltration.
2. Cell disruption techniques– ultra sonication, French pressure cell.
3. Cell disruption techniques–Enzyme and chemical method.
4. Precipitation–ammonium sulphite precipitation.
5. Ultrafiltration separation.
6. Aqueous two phase extraction of biologicals.
7. High resolution purification–affinity chromatography.
8. High resolution purification–ion exchange chromatography.
9. Product polishing–gel filtration chromatography.
10. Product polishing spray drying freeze drying.

Total Periods: 45

References:

1. Belter P.A., Cussler E.L., Houhu W., "Bioseparations: Downstream Processing for Biotechnology", Wiley Interscience Publications., 1st edition, (2011).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2							2	1	2	1	2
CO2	1	2	1	2								1	1	2	1	2
CO3	3	3	1	2			2		3			3	1	3	1	1
CO4	1	1	2	1	3					3		2	1	2	1	2
CO5	3	2	1	1		2						1	2	2	1	2
CO6	3	1	2	1	2							2	2	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BT87 **PROJECT WORK** **L-T-P -0-12** **C 6**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PROJ**

Prerequisites:

Aim: To develop students' knowledge for solving technical problems through structured project research study in order to produce competent and sound engineers.

Course Outcomes:

The Students will be able to

CO1 Identify and describe the problem and scope of project clearly.
CO2 Collect, analyze and present data into meaningful information using relevant tools.
CO3 Select, plan and execute a proper methodology in problem solving.
CO4 Work independently and ethically.
CO5 Present the results in written and oral format effectively.
CO6 Identify basic entrepreneurship skills in project management.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	1	1	1	1	2	1	2	2	2	2	3	2
CO2	2	3	2	2	1	1	1	2	2	1	2	2	3	2	2	1
CO3	2	3	2	1		1	1	2	3	1	2	1	3	3	3	1
CO4	1	2	1	1	2	3		3	2	1	3	2	2	2	2	1
CO5	1	2	1	2	1	3		2	2	1	2	1	1	2	2	1
CO6	1	2	1	1	1	2		1	3	1	3	1	2	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE01 **BIOPHYSICS** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To familiarize with the conjugational study between physics and biology in its structural and working principle.

Course Outcomes:

After completion of this course students able to

CO1. Define the physical nature and properties of biological molecule.
CO2. Develop structural similarities and modifications of protein and nucleic acids.
CO3. Understand the physical mode of biomolecule transportation.
CO4. Analyze the coordination of physical action with biological action.
CO5. Evolve the basic concepts of thermodynamics in biology.
CO6. Apply biophysical knowledge in Physiological in medicinal field.

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.

CONFORMATION OF NUCLEICACIDS **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.

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.

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.

ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS **9**

Concepts in thermodynamics–force and motion–entropy and stability–analyzes of luxes– diffusion potential–basic properties of fluids and biomaterials–laminar and turbulent.

Total Periods: 45

Text Books:

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

References:

1. Voet and voet, biochemistry, 2ndedition, John Wiley and Sons Inc., 1995.
2. Lehninger's Principles of biochemistry David L. Nelson and Micheal Mcox, Macmillon worth publications, 4th edition 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	2							3	2	2	1	1
CO2	1	2	1	2	3					1			1	1	1	1
CO3	1	1	2		2		1						1	1	1	1
CO4	2	1	1	2	2	1							1	1	1	2
CO5	2	1	1	2	2	1							1	1	1	2
CO6	2	1	2	1	1	1		1	1				1	1		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE02 **BIOLOGICAL SPECTROSCOPY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the students in the area of Biological spectroscopy with a clear knowledge in High grade optical instruments to view and characterize biological molecules.

Course Outcomes:

After completion of this course students able to

CO1. Understand polarization of chiral molecules and structural nature of DNA.
CO2. Enumerate the structural elucidation technique by using NMR spectroscopy.
CO3. Expertise in biomolecule crystallization and diffraction process.
CO4. Find latest techniques and methodology for characterization of biomolecule.
CO5. Acknowledge food safety, food quality, food plant Sanitation, food laws and regulations.
CO6. Implement spectroscopy concepts in the industries large scale food processing.

OPTICAL ROTATORY DISPERSION **9**

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

NUCLEAR MAGNETIC RESONANCE **9**

Chemical shifts–spin–spin coupling– relaxation mechanisms–nuclear over hauser effect–multi dimensional NMR spectroscopy–determination of macromolecular structure by NMR–magnetic resonance imaging.

MASS SPECTROMETRY **9**

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

X-RAY DIFFRACTION **9**

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

SPECIAL TOPICS AND APPLICATIONS **9**

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

Total Periods: 45

Text Books:

1. Hammes, G. G., "Spectroscopy for the Biological Sciences", Wiley-Blackwell, 1st Edition, 2005.
2. Atkins P.W. "Physical Chemistry", Oxford IV Edition, 1990.

References:

1. Lawrence B., Jacques R., "In Vivo Spectroscopy (Biological Magnetic Resonance)", Springer, 1st Edition, reprint, 2013.
2. Nicolau B., "Carbon-13 NMR Spectroscopy of Biological Systems", Academic Press, 1st Edition, 2005.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	2	2							2	3	1	2	1
CO2	1	3	2		2					1			1			2
CO3	2	2	2	2	3	1						1		2		
CO4	1	2	1	2	2	2		2							2	
CO5	1	2	1	2		2		3		2		1	1	3		
CO6	1	2	1	2	1	2		2		1			1	2		

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE03 **DEVELOPMENTAL BIOLOGY** **L-T-P** **C**

3-1-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: This course aims to develop the skills of the students in the area of developmental biology. This is a pre-requisite for courses offered in Biotechnology.

Course Outcomes:

After completion of this course students able to

CO1. Understand the basic concepts of developmental biology
CO2. Develop major ideas in cell formation and developmental biology
CO3. Acquire an idea about fertilization and cleavage process
CO4. Understand the process and consequence of gastrulation and organogenesis
CO5. Understand basic concepts of growth, regeneration and metamorphosis
CO6. Acquire the concepts of gene expression and regulation during early development
CO7. Knowledge about different types of placenta and invitro fertilization

BASIC CONCEPTS IN DEVELOPMENTAL BIOLOGY **10**

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients. Spermatogenesis and Oogenesis in amphibians.

FERTILIZATION AND ZYGOTE FORMATION **8**

Fertilization: Activation of sperm and egg–Sequence of events in sperm entry and Egg surface changes. Zygote formation, cleavage and its types. Double fertilization in plants.

BLASTULATION AND GASTRULATION **10**

Stages of embryo: blastula formation, embryonic fields, gastrulation and formation of germ layers and their fates in amphibians. Neurulation.

METAMORPHOSIS & REGENERATION **9**

Metamorphosis in amphibia, insects and their hormonal regulation-thyroid hormones, ecdysone& juvenile hormone. Homeotic genes. Regeneration – Types, Mechanism of regeneration in amphibia.

PLACENTATION & TERATOGENESIS **8**

Placenta: Classification and functions, in-vitro fertilization –test tube babies. Causes for infertility. Teratogenesis: Genetic and Environmental factors.

Total Periods: 45

Text Books:

1. Developmental Biology by Scott Gilbert -11th edition, Sinauer Associates, 2016.
2. Balinsky – An introduction to embryology CBS college Publishers, 2005.

References:

1. Developmental Biology by Scott Gilbert -10th edition, Sinauer Associates, 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	3	2		2				1	1			
CO2	3	1	2	1	2	1		1				2		2		
CO3	1	2	1	3	1	2	2	2	1	1		3			1	
CO4	1	1	3	1	2	3	2	3		2		1				2
CO5	2	1	2	3	1	2	1	2	1	3	1	2		3		
CO6	2	2	2	3	1	3	2	2	2		2	1			3	
CO7	2	1	2	1	3	2		1			1	2				2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE04 BIOPHARMACEUTICAL TECHNOLOGY L-T-P C
3-0-0 3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To familiarize with the biopharmaceutical technology, drug designing, drug formulation, pharmacokinetics and pharmacodynamics. To understand the application of biopharmaceutical technology in living systems.

Course Outcomes:

After completion of this course students able to

CO1. Understand the basic concepts of drug discovery and development followed by pharmaceutical industries.
CO2. Familiarize the pharmacodynamics and pharmacokinetics of drug.
CO3. Illustrate and design the requirements for drug manufacture.
CO4. Acquiring knowledge about sterile liquid and solid dosage manufacture.
CO5. Compare different types of biopharmaceuticals products.
CO6. Develop a good formulation for biopharmaceutical industry in an effective manner.

INTRODUCTION **9**

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

DRUG ACTION, METABOLISM AND PHARMACOKINETICS **9**

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; Pharmacokinetics.

MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS **9**

Types of reaction process and special requirements for bulk drug manufacture.

PRINCIPLES OF DRUG MANUFACTURE **9**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids–vegetable drugs–topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

BIOPHARMACEUTICALS **9**

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biological.

Total Periods: 45

Text Books:

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

References:

1. Michael E.A., "Pharmaceutics, Design and manufacture of Medicines", Churchille Livingstone, 4th Edition, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	2	3	3	2	3	2		2	1	2	3	3	2
CO2	2	2	2	1			2	3				3	2	3	2	1
CO3	3	3	2	3	2	2	2				3	2	3	2	3	2
CO4	2	3	3	3	2	3	3	3	2	2	2	2	3	3	3	2
CO5	1	3	3	2	3	3	2	3	2			2	3	3	2	1
CO6	3	2	3	2	3	2	2		1			2	3	2	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE05 **PRINCIPLES OF FOOD PROCESSING** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the students in the area of need of Food Process Technology and its applications.

Course Outcomes:

After completion of this course students able to

CO1. Lists the constituents and characteristics of food.
CO2. Identify microorganisms responsible for food spoilage and food borne diseases.
CO3. Organize different techniques used for the preservation of foods.
CO4. Examine different additives present in the food.
CO5. Relate microbial activity and freezing characteristics with food quality.
CO6. Implement these overall concepts in the industries large scale food processing.

FOOD AND ENERGY **9**

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

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.

MICROORGANISMS ASSOCIATED WITH FOOD **9**

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

FOOD BORNE DISEASES **9**

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

FOOD PRESERVATION **9**

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

Total Periods: 45

Text Books:

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

References:

1. W.C.Frazier and D.C. Westhoff–Food Microbiology, 4th Ed., McGraw-Hill Book Co., NewYork,1988.
2. J.M.Jay–Modern Food Microbiology, CBS Pub. New Delhi, 1987.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	3	2		2	1	1		2	1	2	2	2	3
CO2	1	2	2	2	3	1							2	1	2	1
CO3	1	1	1	3	2	2	1			2			1	2	1	1
CO4	1	2	2	2	3		2		1				1	2	1	2
CO5	1	1	3	2	2	1		2			2		1	1	2	1
CO6	2	1	1	2	1	2		2		1			1	2	1	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE06 **MARINE BIOTECHNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To study the field of biotechnology in marine environment and its potent application in pharmacology, aqua culture etc.

Course Outcomes:

After completion of this course students able to

CO1. Aware on properties of sea water and biological cycle in marine ecosystem.
CO2. Familiar with biodegradation and bioremediation applicable for marine pollution.
CO3. Find the sources of medicinal compound from marine flora and fauna.
CO4. Analyze the importance of marine organisms in biogeochemical cycles and global climate change.
CO5. Develop aquaculture technology.
CO6. Retrieving knowledge on process of drug discovery from marine organisms.

INTRODUCTION TO MARINE ENVIRONMENT **9**

World ocean sans 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.

IMPORTANT MARINE ORGANISMS **9**

Phytoplankton's–zooplanktons–nektons–benthos–marinemammals–marinealgae–mangroves–coralreefs–deep sea animals and adaptation–intertidal zone–fauna and flora.

MARINE ENVIRONMENTAL BIOTECHNOLOGY **9**

Marine pollution – biology indicators (marine micro, algae) – biodegradation &bioremediation–marine fouling and corrosion.

MARINE PHARMACOLOGY **9**

Medicinal compound from marine flora and fauna – marine toxins, antiviral and antimicrobial agents.

AQUACULTURE TECHNOLOGY **9**

Important of coastal aquaculture–marine fishery resources–common fishing crafts and gears–aqua farm design and construction.

Total Periods: 45

Text Books:

1. M.Fingerman, R .Nagabhushanam, Recent advances in marine biotechnology volume 3, Mary–Frances Thomson.
2. Se-kwon Kim and J Venkatesan, Hand Book of Marine Biotechnology, Springer, 2015.

References:

1. Le Gal, Yves, Ulber, Roland, Marine Biotechnology, Springer, 2005

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	1		2				1	2	2	2		1
CO2	3	2	3	2		1			1				3	1		1
CO3	1	2	2	3	2	2		1			2		2	2	1	3
CO4	2	1	2	2	3			2					3	2	2	1
CO5	3	2	1	2		2					2		2	3		1
CO6	2	3				3							3	2	1	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE07 **ANIMAL BIOTECHNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the students in the area of animal biotechnology and its applications.

Course Outcomes:

After completion of this course students able to

CO1 Study the Fundamentals of Animal cell culture, maintenance and their preservation.
CO2 Provide the details of the diseases and their diagnosis.
CO3 Understand the recombinant and gene therapy for animal diseases.
CO4 Offer the knowledge about the micromanipulation of embryo's.
CO5 Explore the techniques in transgenic animals and stem cell therapy.
CO6.Understand various biotechnologies available to the animal related fields.

ANIMAL CELL CULTURE **9**

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures- suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures.

ANIMAL DISEASES AND THEIR DIAGNOSIS **9**

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

THERAPY OF ANIMAL DISEASES **9**

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

MICRO MANIPULATION OF EMBRYO'S **9**

What is micromanipulation technology; equipment used in micro manipulation; 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.

TRANSGENICANIMALS **9**

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 Periods: 45

Text Books:

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

References:

1. MastersJ.R.W. Animal Cell Culture: Practical Approach Oxford University Press, 2000.
2. R.Ian Freshney, Culture of Animal cells, A Manual of basic technique 4th Edition, 2002.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	3		2			1			2	3	2	1	
CO2	1	2	2	2	3			1					2	1	2	
CO3	2	1	1	2	3	2				2			2	2	3	1
CO4	2	2	2	2	2		1						2	1		2
CO5	3	2	1	3	2	2			1				3	2	1	2
CO6	2	1	1	2		2							2	1		1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE08 **CANCER BIOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Aim: To develop fundamental concepts of cancer, various carcinogens and advanced molecular treatment established for cancer.

Course Outcomes:

After completion of this course students able to

CO1: To learn cellular mechanisms of cancer and also acquired knowledge about molecular aspects of cancer.

CO2: Familiar with basic facts of carcinogenesis and understand the cancer causing agents.

CO3: Understand how a cancer cell develops into a malignant tumor by carcinogenesis.

CO4: Knowledge about the different types of cancer and its prevention.

CO5: Describe different types of therapy for cancer.

CO6: Enhanced immunological based detection and diagnostic method.

FUNDAMENTALS OF CANCER BIOLOGY **9**

Cancer: Definition, causes, classification; cancer epidemiology, role of various factors in development of cancer, Regulation of cell cycle, mutations that cause changes in signal molecules, apoptosis and caspases.

PRINCIPLES OF CARCINOGENESIS **9**

Theory of carcinogenesis, Chemical carcinogenesis – History and mechanism of chemical carcinogenesis, Radiation-principles and mechanisms of radiation carcinogenesis. Viral carcinogenesis (Hepatitis Virus and hepatocellular carcinoma)

PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER **9**

Oncogenes – characteristics & types, ras, myc, retroviruses and Oncogenes, tumour suppressor genes – identification & types, p53, rb pathway.

PRINCIPLES OF CANCER METASTATIS **9**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion,

NEW MOLECULES FOR CANCER THERAPY **9**

Different forms of therapy, chemotherapy, radiation therapy; immunotherapy – engineered MAB & vaccines, Gene therapy, photodynamic therapy. Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection.

Total Periods: 45

Text Books:

1. King R. J. B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K, 1996.
2. Ruddon R. W., *Cancer Biology*, Oxford University Press, Oxford, 2007.
3. Maly B.W.J, "Virology A Practical Approach", IRLl Press, Oxford, 1987.
4. Dunmock N.J and Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford,1988.

References:

1. "An Introduction Top Cellular and Molecular Biology of Cancer" Oxford Medical Publications, 1991.
2. S. pelangaris and M. Khan, " The Molecular biology of cancer", zjohn wiley & sons inc., pub. 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1		1		2						2	2	1	2	2
CO2	1	2		2								1	2	1	1	
CO3	1	1		2	3			2			1	3	1	2	2	
CO4	1	2		2	3							2	1	3	2	
CO5	2	1		2		1					1	2		1	2	
CO6	2	1	1	2	2	1		1			2	1	1	2		3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE09 **BIOCONJUGATE TECHNOLOGY** **L-T-P** **C**
3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the Student in the field of Bioconjugate technology and its industrial applications.

Course Outcomes:

After completion of this course students able to

CO1: Understand the mechanism of modification in existing biomolecule and their reaction.
CO2: Develop knowledge on bio labelling and biomarkers.
CO3: Learn technique to modify enzyme action and their application.
CO4: Find solution to formulation of pharmaceutical agents.
CO5. Prepare immunogenic conjugates and its derivatives based on the conjugation technology.
CO6. Apply the Bio conjugate technology into the industrial application and medicinal purposes.

FUNCTIONAL TARGETS **9**

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

CHEMISTRY OF ACIVE GROUPS **9**

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

BIOCONJUGATE REAGENTS **9**

Zero length cross linkers–Homo bifunctional cross linkers–Hetero bifunctional cross linkers– Trifunctional cross linkers– Cleavable reagent systems–tag sand probes.

ENZYME AND NUCLEICACID MODIFICATION AND CONJUGATION **9**

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

BIOCONJUGATE APLICATIONS **9**

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives- Colloidal–gold-labeledproteins–modificationwithsyntheticpolymers.

Total Periods: 45

Text Books:

1. G.T.Hermanson, Bioconjugate Techniques, Academic Press, 2013.

References:

1. Junhua (Alex) Tao and Romas Kazlauskas, Biocatalyst for green chemistry and chemical process development, John Wiley & Sons, 2011.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	2	1				1	1	2	3	2		1
CO2	2	1	3	3	2	2	2	1					2	1		2
CO3	2	3	2	2	3		2			2		1	1	2		1
CO4	3	2	1	3	3	2	1	2	1				3	1	2	
CO5	2	2	1		2			3					2	3	1	1
CO6	1	2	3	1	1	1		2					1	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE10 **STEM CELL TECHNOLOGY** **L-T-P** **C**
3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To explore the basic molecular principles and emerging trends in stem cell technology and its application in various modern therapies.

Course Outcomes:

After completion of this course students able to

CO1: Understanding of stem cells.

CO2: Analysis on therapeutics using stem cells.

CO3: Apply knowledge of stem cells in organ regeneration.

CO4: Examine the potential uses of stem cells.

CO5: Identifying the problems in measuring and preserving stem cells.

CO6. Apply the stem cell regenerative methods to treat various diseases and also implement it in medicinal field.

STEM CELLS AND CELLULAR PEDIGREES **9**

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

STEM CELL CONCEPT IN PLANTS **9**

Stem cell and founder zones in plants–particularly their roots–stem cells of shoot meristems of higher plants.

STEM CELL CONCEPT IN ANIMALS **9**

Skeletal muscle stem cell–Mammary stem cells–intestinal stem cells–keratinocyte stem cells of cornea–skin and hair follicles–fumour stem cells-factors influencing proliferation and differentiation of stem cells–hormone role in differentiation.

HAEMOPOIETIC STEM CELL **9**

Biology–growth factors and the regulation of haemopoietic stem cells.

POTENTIAL USES OF STEM CELLS **9**

Cellulartherapies–vaccines–genetherapy–immunotherapy–tissueengineering – Blood and bone marrow–Fc cells.

Total Periods: 45

Text Books:

1. Satish Totey and Kaushik D. Deb, Stem Cell Technologies: Basics and Applications, McGraw-Hill, 2010

References:

1. Kyle C., Curtis L.C., "Perinatal Stem Cells", Wiley-Blackwell, 2nd Edition, 2013.
2. Lanza R., Gearhart J., "Essential of Stem Cell Biology". Elsevier Academic press, 1st Edition 2009.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2							2	2	1	2	1
CO2	2	1	2	3	3	2	2	1		1	1		2	2	2	2
CO3	2	2	1	3	3	1		2	1	1			1	1	2	
CO4	1	2	3	2	2		1			2	1		2	3	2	2
CO5	1	1	2	2	2	1	2	2	2				2	1	1	2
CO6	1	2	1	3	1	1		3					1	2	2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE11	MOLECULAR PATHOGENESIS	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the students in the area of molecular principles of Molecular Pathogenesis

Course Outcomes:

After completion of this course students able to

CO1: Find and solve contamination and spoilage organic matter.
CO2: Familiar with effects of contamination and precautions.
CO3: Identification of contaminant and pathogen with their mode of action.
CO4: Characterize the virulence organisms.
CO5: Implementation of modern methods foe pathogenic experiments.
CO6:Apply various control measures to treat pathogen infection in medicinal field.

OVERVIEW **9**

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

HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES **9**

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

MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **9**

Virulence, virulence factors, virulence-associated factors and virulence life style factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival *E.coli* pathogens: Entero toxigenic, Entero-pathogenic and Entero aggregative *E.coli*. Pathogenic plasmodium and knob Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Influenza virus: Intracellular stages, Neuraminidase & Haem agglutininin entry, M1&M2 proteins in assembly and disassembly, action of immune line.

EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS **9**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses.

MODERN APPROACHESTOCONTROLPATHOGENS **9**

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immune & 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 Periods: 45

Text Books:

1. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.
2. Tizard: Immunology; Anintroduction;4thEdition, Thomson Publication.
3. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol.27", AcademicPress,1998.
4. Abigali A.Salyers and Dixie D. Whitt, Bacterial Pathogenesis – A molecular Approach, Second Edition, ASM Press, Washington, 2002.

References:

1. Recent reviews in Infect. Immun., Mol. Microbiol, Biochem. J., EMBO etc.
2. Nester, Anderson, Roberts, Pearsall, Nester,"Microbiology: Ahuman Perspective", McGraw-Hill, 3rd Edition, 2001.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	2		1		1		2		2	2	2	1
CO2	2	1	3	2	2	2				1		2	2	2	1	
CO3	3	2	2	2	3	1	2	1					3	2	1	2
CO4	1	2	1	2	1	2		2	1			1	2	1		2
CO5	2	2	1	3	2	2	1		2				2	2	2	
CO6	3	2	2	3	1	1		3		1		1	1	1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE12 MOLECULAR MODELING AND DRUG DESIGN **L-T-P** **C**
3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop skills of students in the area of Molecular modelling.

Course Outcomes:

CO1. Acquire with theoretical and practical knowledge of molecular modelling tools and techniques for drug design and discovery.

CO2. Develop knowledge of molecular modelling software will be useful for commercial projects related to drug discovery and developments.

CO3. Learn molecular docking knowledge and skill.

CO4. Model of protein target-small molecule interactions, molecular docking, and optimization.

CO5. Interpret the Combinatorial chemistry and library design, Virtual screening of drugs.

CO6. Analyze the toxicity (ADMET) property, Pharmacophore and QSAR.

MOLECULAR GEOMETRY **9**

Introduction to Molecular Geometry, Coordinate Space for Optimization of Algorithm of Molecular Geometry, Z-Matrix, Molecular Vibrations, Electrostatic Charges, Electrostatic Charges, Multipole Moments, Fermi Contact Density, Electronic Spatial Extent and Molecular Volume, Electron Affinity and Ionization Potential, Hyperfine Coupling, Dielectric Constant, Force Field Customization.

PHARMACOPHORE **9**

Historical Perspective and Viewpoint of Pharmacophore, Functional Groups Considered as Pharmacophores, Ehrlich's "Magic Bullet", Fischer's "Lock and Key", Two-dimensional Pharmacophores, Three-dimensional Approach of Pharmacophores, Criteria for Pharmacophore Model, Pharmacophore Model Generation Software Tools, Molecular Alignments, Handling Flexibility, Alignment Techniques, Scoring and Optimization, Pharmacophores, Validation and Usage, Automated Pharmacophore Generation Methods, GRID-based Pharmacophore Models, Pharmacophores for Hit Identification, Pharmacophores for Human ADME/Tox-related Protein.

MOLECULAR DOCKING **9**

Introduction to molecular docking, Rigid docking, Flexible docking, manual docking, Advantage and disadvantage of Flex-X, Flex-S, AUTODOCK and other docking software, Scoring Functions, Simple Interaction Energies, GB/SA scoring (implicit solvation), C Score (consensus scoring algorithms).

LIBRARY AND DATABASE **9**

Molecular and Structural Database, Protein Data Bank, Bioactivity Databases, Gene and Protein Sequence Databases, Cambridge Crystallographic Database, Compound Storage and Management.

SOFTWARE RESOURCES **9**

Methods–Basic sets–Model chemiststrix–inputs–outputs–uses.

Total Periods: 45

Text Books:

1. K Anand Solomon, Molecular Modeling and Drug Design, MJP Publishers, 2008.
2. D.McQuarrie, Quantum Mechanics; Narosa, 1999.

References:

1. Guidebook on Molecular Modeling in Drug Design, Academic Press, 1996.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1		1					2	3	2	1	2
CO2	2	3	2	2		1				2			3	2	1	1
CO3	1	2	2	3	2			1					2	1	1	2
CO4	3	2	2	1		1		2		1			2	3	1	1
CO5	2	1	3		2			1			1		3	1	1	2
CO6	2	1	2	2		1			2			3	3	2	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE13 **METABOLIC ENGINEERING** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop skills of the students in the area of Metabolic Engineering principle & its application in bioprocess, molecular therapeutics & genetic engineering etc.

Course Outcomes:

After completion of this course students able to

CO1: Gain the knowledge of Process of metabolism and their regulation is understood.
CO2: Apply the metabolic reactions in the synthesis of primary and secondary metabolites.
CO3: Perform bioconversion of biological molecule features.
CO4: Select good strain, improvement and enhance enzyme production methods.
CO5: Develop knowledge on feedback regulation to improve the production.
CO6: Design effective strategies to implement genetic manipulations.

INTRODUCTION **9**

Induction-jacob monod model, catabolite regulation, glucose effect, camp deficiency, feedback regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feedback regulation, cumulative feedback regulation, energy charge, aminoacid regulation of RNA synthesis, energy charge, regulation, permeability control passive diffusion, active transport group transportation.

SYNTHESIS OF PRIMARY METABOLITES **9**

Alteration of feedback regulation, limiting accumulation of end products, feedback, resistant mutants, alteration of permeability, metabolites.

BIOSYNTHESIS OF SECONDARY METABOLITES **9**

Precursor effects prophophase, idiophase relationship, enzyme induction, feedback regulation, catabolite regulation bypassing control of secondary metabolism, producers of secondary metabolites.

BIOCONVERSIONS **9**

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

REGULATION OF ENZYME PRODUCTION **9**

Strain selection, improving fermentation, recognizing growth cycle peak, induction, feedback repression, catabolite repression, mutants resistant to repression, gene dosage.

Total Periods: 45

Text Books:

1. Wang D.I.C., Cooney C.L., DemainA.L., Dunnil.P., Humphery A.E., Lilly M.D., "Fermentation and Enzyme Technology", John Wiley and Sons., 1980.
2. Stanbury P.F., and Whitaker A., "Principles of Fermentation Technology", Pergamon Press, 1984.

References:

1. Zubay G.," Biochemistry", Macmillan Publishers, 1989.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	1		2			1		2	3	2	1	1
CO2	1	2	3	2	2	1		1			1		3	2	1	2
CO3	1	1	2	3	2	2	1		1				3	2	3	1
CO4	1	2	3	2	1	2						1	2	2	1	1
CO5	2	3	1	2		2					2	2	3	2	2	1
CO6	2	2	3		1			2				1		1	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE14 **IMMUNOTECHNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of the students in the area of Immunotechnology.

Course Outcomes:

After completion of this course students able to

CO1: Identify the properties of antigen and antibodies with their action.

CO2: Develop techniques to diagnosis of immunological related health issues.

CO3: Implementation of suitable techniques to assess immunity.

CO4: Generate vaccines production methods and immunotherapeutics.

CO5: Find latest trends in immunological scientific development.

CO6: Apply knowledge to develop vaccine, clinical diagnosis and therapies for autoimmune diseases.

ANTIGENS **9**

Types of antigens, their structure, preparation of antigens for raising antibodies, handling of animals, adjuvants and their mode of action.

ANTIBODIES & IMMUNODIAGNOSIS **9**

Monoclonal and polyclonal antibodies–their production and characterization, western blot analysis, immune electrophoresis, SDS-PAGE, purification and synthesis of antigens, ELISA-principle and applications, radio immunoassay(RIA) principles and applications, non-isotopic methods of detection of antigens –enhanced chem. Luminescence assay.

ASSEMENT OF CELL MEDIATED IMMUNITY **9**

Identification of lymphocytes based on CD markers, Tcell activation parameters, cytokine Bioassay, macrophages activation, macrophage microbicidal assays, FACS, HLA typing.

VACCINE TECHNOLOGY **9**

Basic principles of vaccine development, protein based vaccines, DNA vaccines, Plant based vaccines, Recombinant antigens as vaccines, Reverse Vaccinology.

DEVELOPMENT OF IMMUNOTHERAPEUTICS **9**

Engineered antibodies, catalytic antibodies, production of idiotypic and antidiotypic antibodies, combinatorial libraries for antibody isolation.

CURRENT TOPICS IN IMMUNOLOGY

Trends in Immunology of infectious diseases and tumors, topics as identified from time to time.

Total Periods: 45

Text Books:

1. Talwar G.P. and Gupta S.K., "A hand book of practical and clinical immunology" Vol. 1&2, CBS Publications, 1992.
2. Weir D.M., Practical Immunology, Blackwell Scientific Publications, Oxford, 1990.

References:

1. Austin J.M. and Wood K. J., Principle of cellular and molecular immunology, Oxford university press, Oxford, 1993.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	2	3	2		1		1			2	3	1	2	2
CO2	1	2	3	3	2	2		1			1		3	2	2	1
CO3	2	3	2	3	2	1	2			1			3	1	2	2
CO4	2	1	3	2	1	2		2				1	2	1	2	1
CO5	1	2	2	3		1	2		2				3	2	1	2
CO6	2	1	2	2		2			2				2	3	2	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE15 NEUROBIOLOGY AND COGNITIVE SCIENCES L-T-P C
3-0-0 3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To develop the skills of students in the area of macro biology and cognitive sciences.

Course Outcomes:

After completion of this course students able to

CO1: Able to understand the neurological system with their related issues.
CO2: Evaluate the pharmacological solution and neuro hormones interaction.
CO3: Mechanism of sensation and their role in physiological system is known.
CO4: Analyze the reasons for behavior changes and associated disorders.
CO5: Study various animal behaviour using animal models for clinical investigation.
CO6. Apply the knowledge of animal neuron system to treat various related diseases.

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.

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.

NEUROPHARMACOLOGY **9**

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

APPLIEDNEUROBIOLOGY **9**

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

BEHAVIOURSCIENCE **9**

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

Total Periods: 45

Text Books:

1. Mathews G.G.Neurobiology,2nd edition, Blackwell Science, UK, 2000.

References:

1. John Hart JR, The neurobiology of cognition and behavior, Oxford University press, 2016.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	3	2		2					2	2		2	3
CO2	3	2	2	3	2	2		1		1			2	1	3	2
CO3	3	2	3	2	3	1	1	2			1		1	2	2	2
CO4	1	2	1	3	2				2				2	2	2	1
CO5	2	1	2	1				3			2		1	2	2	1
CO6	1	2	1	3	1			2			1		1	2	3	1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161BTE16	PROCESS INSTRUMENTATION DYNAMICS AND CONTROL	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **PE**

Prerequisites:

Aim: To introduce control equipment used to control the production process of a chemical factory and to introduce the control mechanism through automation and computers.

Course Outcomes:

After completion of this course students able to

CO1. Understanding the basic concepts of process instrumentation and control systems.
CO2. Able to apply various transforms and numerical methods to design the control systems.
CO3. Acquire ideas about principle and mechanism of various industrially based controllers.
CO4. Gain knowledge about process automation and about the instruments used to manage the performance of control systems.
CO5. Design the process control loops for process engineering.
CO6. Devise simple effective plant wide control strategies using appropriate heuristics.

TRANSFORMATION **9**

Laplace transformation, transform of standard functions, derivatives and integrals, inversion, theorems in Laplace transformation, application .Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transfer function for chemical reactors and dynamics.

CONTROL SYSTEM **9**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulator problems, Transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transportation lag, transient response of closed-loop control systems and their stability.

RESPONSE AND CONTROL **9**

Introduction to frequency response of closed-loop systems, control system design by frequency, Bode diagram, stability criterion, Nyquist diagram; Tuning of controller settings.

PROCESS REGULATION **9**

Controller mechanism, introduction to advanced control systems, cascade control, feed forward control, control of distillation towers and heat exchangers, introduction to microprocessors and computer control of chemical processes.

FACTORS MEASUREMENTS **9**

Principles of measurements and classification of processcontrol instruments, measurementsoftemperature,pressure,fluidflow,liquidweightandweightflowrate, viscosity and consistency, pH, concentration, electrical and thermal conductivity, humidity of gases, composition by physical and chemical properties and spectroscopy.

Total Periods: 45

Text Books:

1. Coughnowr and Koppel, “Process Systems Analysis and Control”, McGraw-Hill, New York, 1986.
2. George Stephanopolous, “Chemical Process Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1990.

References:

1. Thomas, E. Marlin, Process Control, 2nd Edn, McGraw-Hills International Edition. 2000.
2. George Stephanopoulos, Chemical Process Control, Prentice Hall of India 2003.
3. Norman H.CEAGLSKE, Automatic process control for chemical engineers, John Wiley & Sons.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	2	2	3	2	2			2	3	2	2	1
CO2	3	3	1	2	2		2	2	2	2			2	2	2	2
CO3	3	2	2	2	2		3					2	3	3	2	2
CO4	3	3	2	2		2	2		2		1	2	3	2	2	2
CO5	3	2	3	2				1	1	1	2		2	3		1
CO6	3	2	2	2		2		2			1		3	2		1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE501 PROCESS EQUIPMENTS AND PLANT DESIGN L-T-P C
3-0-0 3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **OE**

Prerequisites:

Aim: To develop the skills of the students in the area of process equipment and Design.

Course Outcomes:

After completion of this course students able to

CO1. Understand the basic concepts of process equipments and designing.
CO2. Acquire knowledge designing the reactor vessels and other equipments.
CO3. Acquire knowledge to construct the product recovery units.
CO4. Acquire ideas to design the basic requirements like pump, valves, pipes and seal.
CO5. Develop various piping and construction materials for modern plant unit.
CO6. Create product based plant unit with basic requirement for industrial case studies.

HEAT EXCHANGERS, CONDENSERS, EVAPORATORS **9**

Single and multiprocess exchangers, double pipe, U tube heat exchangers, combustion details supporting structure. Single and vertical tube evaporation, Single and multi-effect evaporators, forced circulation evaporators

STORAGE VESSEL FOR VOLATILE AND NONVOLATILE FLUIDS, PRESSUREVESSEL STRUCTURE **9**

Design of the following equipments as per ASME, ISI codes, drawing according to scale; Mono block and multiplayer vessels, combustion details and supporting structure.

EXTRACTOR, DISTILLATION AND ABSORPTION TOWER **9**

Construction details and assembly drawing; Plate and Packed Extraction Towers; Plate and Packed absorption Towers; Plate and Packed Distillation Towers.

PUMPS, MECHANICAL SEALS, VALVES AND SWITCHES **9**

Various types of pumps, Principle of working, construction, usages, advantages and disadvantages; Various types of seals, effectiveness, usages; Pneumatic Seals; Gate, Globe and Butterfly Valves, their material of construction; Pneumatically Controlled Valves.

PIPING, PLANT LAYOUT AND DESIGN **9**

Various types of Piping, material of construction, their usage; Pipe layout; Modern Plant Design and case studies.

Total Periods: 45

Text Books:

1. Brownbell I.E., YoungE.H., Chemical Plant Design, 1985.
2. Kern D.Q. “Heat Transfer”, McGraw-Hill, 1985.

References:

1. Mc Cabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, McGraw-Hill, 1976.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	2	2		1	2		1	3	2	2	2
CO2	3	3	2		3		3			3			3	2	2	2
CO3	3	2	2	3	2	2				2		3	3	3	2	3
CO4	3	3	3	3	2	2				2		3	3	3	3	2
CO5	1	2	2	2				1	1	1	2		2	3	2	1
CO6	2	3	2	2		2		2			1		3	2		1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE502 **BIOMATERIALS** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **OE**

Prerequisites:

Aim: To develop the skills of the students in the area of biological materials and application.

Course Outcomes:

After completion of this course students able to

CO1 Define the fundamentals of Biomaterials.

CO2 Understand the polymers as biomaterials and their uses.

CO3 Familiarize with the tissue graft and soft tissue application.

CO4 Learn the implants in cardiovascular and ophthalmology.

CO5 Explore the Orthopaedic and dental materials.

CO6: create the Awareness about the properties and broad applications of biomaterials.

FUNDAMENTALS OF BIOMATERIALS **9**

Overview of biomaterials, structure and properties of biomaterials- (physical and mechanical), Sterilization and quality improvement.

SYNTHETIC AND BIOPOLYMERS **9**

Polymers in biomedical use- polyethylene, polypropylene and perfluorinated polymers, hydrogels, polyurethanes, polyamides, biodegradable synthetic polymers, silicone rubber. Collagens, elastin, mucopolysaccharides, proteoglycans, cellulose and derivatives, chitin and others.

TISSUE GRAFTS AND SOFT TISSUE APPLICATION **9**

Tissue grafts and rejection processes – blood, skin and connective tissue, bulk space fillers, maxillofacial and fluid transfer implants, percutaneous devices, biomaterials in urological practice and microencapsulation of live animal cells.

BIOMATERIALS IN CARDIOVASCULAR AND OPHTHALMOLOGY **9**

Implants in blood vessels, heart, kidney, lungs, cardiac pacemakers and blood substitutes, Viscoelastic solutions, contact lenses, optical implants and artificial tears.

ORTHOPAEDIC AND DENTAL MATERIALS **9**

Bone composition and properties, temporary fixation devices, joint replacement and repair and bone regeneration. Teeth composition and mechanical properties, filling and restorative materials, metals in dentistry and oral implants.

Total Periods: 45

Text Books:

1. Sujata V. Bhat, Biomaterials, 2nd Edition, Narosa Publishing House, 2010.

References:

1. J.S. Temenoff and A.G. Mikos, "The Introduction of Biology and material science", Pearson Education, New Delhi, 2009

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	1		1			1		2	3	1	3	1
CO2	2	3	2	3	2	1		1			1		3		3	2
CO3	2	2	2	3	2	2	1		1				2	1	2	2
CO4	1	2	1	2	1		2	1		2			3	2	3	1
CO5	1	1	3	2	2	1			1		2		2	2	3	2
CO6	2	3	2	2			1			2		3	2	1	2	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE503	BIOSENSORS	L-T-P	C
		3-0-0	3

Programme: B. Tech Bio-Technology **Sem:** **Category:** **OE**

Prerequisites:

Aim: To develop the skills of the students about the different types of biosensors.

Course Outcomes:

After completion of this course students able to

CO1. Demonstrate the importance of using biomolecules as sensors.
CO2. Deliver the impact transduction and choice of sensing elements in biosensor design.
CO3. Understand the role of enzymatic sensors and immunosensors.
CO4. Apply nanotechniques in design of Biosensors.
CO5. Evaluate clinical and non-clinical uses of biosensors.
CO6. Recognize the concepts behind the reagent less biosensors & array-based chips.

FUNDAMENTALS OF BIOSENSOR **9**

Definition - Historical development - Important aspects of sensors - Recognition elements - Transducers Methods of Immobilization of the Receptor Component in Biosensors - Signal transduction; Physico-chemical and Biological transducers - Performance factors: calibration, selectivity, sensitivity, reproducibility, detection limits, response time.

TRANSDUCTION AND SENSING ELEMENTS **9**

Electrochemical Transducers - Potentiometry and Ion-Selective Electrodes - The Nernst Equation - Voltammetry and Amperometry - Conductivity - Field-Effect Transistors - Ionic Recognition - Molecular Recognition - Biological Recognition elements - Choice of bioreceptor - Choice of transducer.

ENZYMATIC SENSORS **9**

Some Enzymes with Relevance to Biosensors - Transduction Methods in Enzymatic Biosensors - Potentiometric enzyme electrodes - Amperometric enzyme electrodes - Semiconductor enzyme sensors - Optical enzyme sensors - Thermal enzyme sensors - Piezoelectric enzyme sensors.

IMMUNOLOGICAL SENSORS **9**

General Principles - Immobilization Methods in Immunosensors - Immunoassay Formats - Membrane Immunosensors - Piezoelectric Systems - Optical Immunosensors - Biosensors Using Intact Biological Receptors.

NANOTECHNOLOGY BASED BIOSENSORS **9**

Nanomaterials for Sensing Applications - Signal Amplification Using Nanomaterials for Biosensing - Nanomaterial-Based Electroanalytical Biosensors for Cancer and Bone Disease - Gold Nanostructure LSPR-Based Biosensors for Biomedical Diagnosis - DNA Sensors Employing Nanomaterials for Diagnostic Applications.

Total Periods: 45

Text Books:

1. Eiggns B. R., "Chemical sensors and Biosensors", John Wiley & Sons Ltd,1st Edition, 2003.
2. Banica F. G., "Chemical sensors and Biosensors Fundamentals and Applications" John Wiley & Sons Ltd, 1st Edition, 2012.

References:

1. Serra P.A., "Biosensors", Intech Publishers, 1st Edition, 2010.
2. Tuantranont A ., "Applications of Nanomaterials in Sensors and Diagnostics", Springer, 2013.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	1		1			1			2			2
CO2	3	2	1	2	2	1		1			2	1	2			2
CO3	2	1	2	3	2	1			1				3			2
CO4	3	2	1	2	3	2		1				2	3	3	2	3
CO5	2	3	2	3	2	1			1				3	2	2	2
CO6	3	2	1	2	3	2		1				2	1	3	2	3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

161OE504 **FOOD SCIENCE AND TECHNOLOGY** **L-T-P** **C**

3-0-0 **3**

Programme: B. Tech Bio-Technology **Sem:** **Category:** **OE**

Prerequisites:

Aim: To develop the skills of the students in the area of food science and technology.

Course Outcomes:

After completion of this course students able to

CO1: Understanding the techniques in manufacture of food products.
CO2: Identify microorganisms responsible for food spoilage and food borne diseases.
CO3: Organize different techniques used for the preservation of foods.
CO4: Examine different constituents and additives present in the food.
CO5: Ability to work in various manufacturing sectors of long storage foods.
CO6: Popularize different microorganism involved in food processing.

NUTRITIONAL VALUE OF NATURAL FOODS **9**

Nutritional values of cereals, pulses, fruits, vegetables and meats. Food ingredients and adulteration.

SCOPE AND IMPORTANCE OF FOOD PROCESSING **9**

National and international perspectives. Principles and methods of food processing and preservation (freezing, heating, dehydration, canning, additives, fermentation, irradiation, extrusion cooking, dielectric heating).

MILK AND MILK PRODUCTS **9**

Milk and milk products: composition, properties and nutritional importance of milk, processing of milk, study of some common milk products (cheese, ice cream, yoghurt); Beverages: processing of some common beverages (tea, coffee); Sugar and confectionary: composition, nutritive value, crystallization, caramellization, hydrolysis; Indian confectionary, Chikki: source of energy.

FOOD PACKAGING **9**

Food Packaging: Packaging materials & its advancement, Mass transfer in packing material, Innovation in food packing (active, passive, intelligent), Package testing, CA & MA, Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biological reactions.

FOOD HYGINE AND SANITATION **9**

Food poisoning and food borne illness (Bacterial& non-bacterial), and their control. Contamination during handling and processing and its control; Method for microbial examination of food: indicator organisms, direct examination, cultural techniques, Rapid methods in detection of microorganisms.

Total Periods: 45

Text Books:

1. S.Sood , Food presevation & processing, Kalyani publ.
2. Food Science- N.Potter & J.H.Hotchkiss- CBS Publishers & Distributors, New Delhi.

References:

1. Toxicological aspects of food: Eds. Miller Elsevier -scientific publications.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	2	2	1				2		2	3	2		1
CO2	1	2	2	3	1		2	1					2	2		1
CO3	2	2	2	2	3	2			2		1		1	3		2
CO4	2	2	1	2	2		1			1			1	2	1	2
CO5	2	1	1	2	1	2	2	1		2			2	2		2
CO6	1	2	2	2			1		1				2		2	2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)