DEPARTMENT OF BIOTECHNOLOGY

SEMESTER – I

Course Code	Course Title	C	L	T/SLr	P/R	Ty/Lb/ ETL
BEN17001	TECHNICAL ENGLISH –I	2	1	0/0	2/0	Ty
BMA17001 BMA17002	MATHEMATICS – I/ BIO MATHEMATICS (FOR BIOTECH)	4	3	1/0	0/0	Ty
BPH17001	ENGINEERING PHYSICS	3	2	0/1	0/0	Ty
BCH17001	ENGINEERING CHEMISTRY –I	3	2	0/1	0/0	Ty
BES17001	BASIC ELECTRICAL & ELECTRONICS ENGINEERING	3	2	0/1	0/0	Ty
BES17002	BASIC MECHANICAL & CIVIL ENGINEERING	3	2	0/1	0/0	Ty
ANNUAL PATTERN (PRACTICALS)*						
BES17ET1	BASIC ENGINEERING GRAPHICS	2	1	0/0	2/0	ETL
BPH17L01	ENGINEERING PHYSICS LAB	1	0	0/0	2/0	Lb
BCH17L01	ENGINEERING CHEMISTRY LAB	1	0	0/0	2/0	Lb
BES17L01	BASIC ENGINEERING WORSHOP	1	0	0/0	2/0	Lb
BES17ET2	C PROGRAMMING AND LAB	2	1	0/0	2/0	ETL
BES17ET3	ENTREPRENEURIAL SKILL DEVELOPMENT & PROJECT LAB	1	0	0/0	2/0	ETL

Credits Sub Total:26

SEMESTER – II

Course Code	Course Title	C	L	T/SLr	P/R	Ty/Lb/ETL
BEN17002	TECHNICAL ENGLISH – II	2	1	0/0	2/0	Ty
BMA17003 BMA17004	MATHEMATICS – II / BIO STATISTICS (FOR BIOTECH)	4	3	1/0	0/0	Ty
BPH17002	MATERIAL SCIENCE	3	2	0/1	0/0	Ty
BCH17002	ENGINEERING CHEMISTRY – II	3	2	0/1	0/0	Ty
BES17003	ENVIRONMENTAL SCIENCE	3	3	0	0/0	Ty

Credits Subtotal: 15

C: Credits L : Lecture T: Tutorial S.Lr: Supervised Learning P: Problem / Practical R: Research Ty/Lb/ETL : Theory /Lab/Embeddded Theory and Lab * Internal Evaluation

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER – III

THEORY:

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17001	3	BIOCHEMISTRY	4	3	1/0	0/0	Ty
BBT17002	3	ENZYME TECHNOLOGY	4	3	1/0	0/0	Ty
BBT17003	3	MICROBIOLOGY	4	3	1/0	0/0	Ty
BBT17004	3	THERMODYNAMICS AND STOICHIOMETRY	3	3	0/0	0/0	Ty
BCS17I04	2	OBJECT ORIENTED PROGRAMMING FOR BIOTECHNOLOGISTS	3	3	0/0	0/0	Ty

PRACTICAL:

BBT17ET1	3	CELL BIOLOGY *	3	1	0/1	1/1	ETL
BBT17L01	3	BIOCHEMISTRY LAB	1	0	0/0	3/0	Lb
BBT17L02	3	MICROBIOLOGY LAB	1	0	0/0	3/0	Lb
BCS17IL4	2	OBJECT ORIENTED PROGRAMMING LAB	1	0	0/0	3/0	Lb

Credits Sub Total: 24

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER – IV

THEORY:

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BMA17015	2	ADVANCED MATHEMATICS FOR BIOTECHNOLOGISTS	4	3	1/0	0/0	Ty
BBT17005	4	INSTRUMENTATION AND BIOPHYSICS	4	3	1/0	0/0	Ty
BBT17006	3	MICROBIAL BIOTECHNOLOGY	4	3	1/0	0/0	Ty
BBT17007	3	HEAT TRANSFER OPERATIONS	3	3	0/0	0/0	Ty
BCS17I05	3	BIO DATA BASE SYSTEMS	3	3	0/0	0/0	Ty

PRACTICAL:

BSK17ET1	6	SOFT SKILL I*	2	1	0/1	1/0	ETL
BBT17ET2	4	GENETICS *	3	1	0/1	1/1	ETL
BBT17L03	4	INSTRUMENTAL METHODS OF ANALYSIS LAB	1	0	0/0	3/0	Lb
BBT17L04	4	MICROBIAL BIOTECHNOLOGY LAB	1	0	0/0	3/0	Lb
BCS17IL5	3	BIO DATABASE SYSTEMS LAB	1	0	0/0	3/0	Lb
BBT17TS1	7	TECHNICAL SKILL I	1	0	0/0	3/0	Lb

Credits Sub Total: 27

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER –V

THEORY:

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17008	3	IMMUNOLOGY	4	3	1/0	00	TY
BBT17009	4	MOLECULAR BIOLOGY	4	3	1/0	0/0	TY
BBT17010	3	RECOMBINANT DNA TECHNOLOGY	3	3	0/0	0/0	Ty
BBT17011	3	PROTEIN SCIENCE	3	3	0/0	0/0	Ty
BEI17I03	3	BIOPROCESS INSTRUMENTATION AND CONTROL	3	3	0/0	0/0	Ty

PRACTICAL:

BBT17ET3	4	ANIMAL PHYSIOLOGY*	3	1	0/1	1/1	ETL
BBT17L05	4	IMMUNOLOGY LAB	1	0	0/0	3/0	Lb
BBT17L06	4	RECOMBINANT DNA TECHNOLOGY LAB	1	0	0/0	3/0	Lb
BEI17IL03	5	BIOPROCESS CONTROL SYSTEMS LAB	1	0	0/0	3/0	Lb
BBT17TS2	7	TECHNICAL SKILL 2 (EVALUATION)	1	0	0/0	3/0	Lb
BBT17L07	7	IN PLANT TRAINING (EVALUATION)	1	0	0/0	3/0	Lb

Credits Sub Total: 25

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER- VI

THEORY:

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17012	3	BIOPROCESS ENGINEERING	4	2	1/0	0/2	Ty
BBT17013	4	BASIC PHARMACEUTICAL TECHNOLOGY	3	3	0/0	0/0	Ty
BBT17ET	3	ELECTIVE I	3	3	0/0	0/0	Ty
BIT17I01	3	BIOINFORMATICS	3	3	0/0	0/0	Ty
BBT17OE	3	OPEN ELECTIVE (INTER DISCIPLINARY)	3	3	0/0	0/0	Ty

PRACTICAL:

BSK17ET2	6	SOFT SKILL II	2	1	0/1	0/0	ETL
BBT17L08	4	BIOPROCESS LAB	1	0	0/0	3/0	Lb
BBT17L09	4	BIOINFORMATICS LAB	1	0	0/0	3/0	Lb
BBT17L10	4	PHTYO CHEMICAL TECHNIQUES LAB	1	0	0/0	3/0	Lb
BBT17L11	7	MINI PROJECT (EVALUATION)	1	0	0	0	Lb
BBT17TS3	7	TECHNICAL SKILL 3 (EVALUATION)	1	0	0	0	Lb

Credits Sub Total: 23

C: Credits L: Lecture T: Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER: VII

THEORY:

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17014	3	DOWNSTREAM PROCESSING	4	3	1/0	0/0	Ty
BBT17015	4	ANIMAL TISSUE CULTURE	4	3	1/0	0/0	Ty
BBT17ET	3	ELECTIVE – II	3	3	0/0	0/0	Ty
BBT17ET	3	ELECTIVE -III	3	3	0/0	0/0	Ty
BMG17001	3	PRINCIPLES OF MANGEMENT	3	3	0/0	0/0	Ty

PRACTICAL:

BBT17SE	4	SPECIAL ELECTIVE *	3	1	0/2	1/1	ETL
BBT17L12	4	DOWNSTREAM PROCESSING LAB	1	0	0/0	3/0	Lb
BBT17L13	4	ANIMAL TISSUE CULTURE LAB	1	0	0/0	3/0	Lb
BBT17L14	5	PROJECT PHASE -I	2	0	0/0	6/0	Lb
BFL17001	7	FOREIGN LANGUAGE (EVALUATION)	2	1	1/1	0/0	TY

Credits Sub Total: 26

C: Credits L: Lecture T: Tutorial S. Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER- VIII

THEORY:

Course Code	Prerequisite Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBT17ET	5	ELECTIVE IV	3	3	0/0	0/0	Ty
BBT17ET	5	ELECTIVE V	3	3	0/0	0/0	Ty
BMG17003	1	TOTAL QUALITY MANAGEMENT	3	3	0	0	Ty

PRACTICAL:

BBT17L15	7	PROJECT (PHASE – II)	10	24	0/0	24/24	Ty/Lb/ETL

Credits Sub Total: 19

C: Credits L: Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research

Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

*** Internal evaluation (Departmental level Refer Annexure for evaluation methodology)**

Credit Summary

Semester : 1 : 18
Semester : 2 : 23
Semester : 3 : 24
Semester : 4 : 27
Semester : 5 : 25
Semester : 6 : 23
Semester : 7 : 26
Semester : 8 : 19

Total Credits : 185

DEPARTMENT OF BIOTECHNOLOGY

ELECTIVE-I

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17E01	3	ANIMAL BIOTECHNOLOGY	3	3	0/0	0/0	Ty
BBT17E02	4	ENVIRONMENTAL IMPACT ASSESSMENT	3	3	0/0	0/0	Ty
BBT17E03	4	STEM CELLS AND DEVELOPMENTAL BIOLOGY	3	3	0/0	0/0	Ty

ELECTIVE -II

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17E04	3	GENOMICS	3	3	0/0	0/0	Ty
BBT17E05	4	BIO FUELS	3	3	0/0	0/0	Ty
BBT17E06	4	SOLID AND HAZARDOUS WASTE MANAGEMENT	3	3	0/0	0/0	Ty

ELECTIVE –III

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17E07	3	PHYTO CHEMICAL TECHNOLOGY	3	3	0/0	0/0	Ty
BBT17E08	4	FOOD BIOTECHNOLOGY	3	3	0/0	0/0	Ty
BBT17E09	4	CLINICAL BIOCHEMISTRY	3	3	0/0	0/0	Ty

ELECTIVE –IV

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17E10	3	ADVANCES IN AGRICULTURAL BIOTECHNOLOGY	3	3	0/0	0/0	Ty

BBT17E11	4	BIOMATERIALS AND TISSUE ENGINEERING	3	3	0/0	0/0	Ty
BBT17E12	4	ENVIRONMENTAL TOXICOLOGY	3	3	0/0	0/0	Ty

ELECTIVE -V

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17E13	3	CANCER BIOLOGY	3	3	0/0	0/0	Ty
BBT17E14	4	BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	3	3	0/0	0/0	Ty
BBT17E15	4	CLINICAL GENETICS & CYTOGENETICS	3	3	0/0	0/0	Ty
BBT17E16	4	LEGAL ASPECTS OF BIOETCHNOLOGY	3	3	0/0	0/0	Ty

OPEN ELECTIVES

Course Code	Pre requisite Course Code	Course Title	C	L	T/ SLr	P/R	Ty / Lb/ ETL
BBT17OE1	2	FOOD AND NUTRITION	3	3	0/0	0/0	Ty
BBT17OE2	2	HUMAN PHYSIOLOGY	3	3	0/0	0/0	Ty
BBT17OE3	2	CLINICAL BIOCHEMISTRY	3	3	0/0	0/0	Ty
BBT17OE4	2	PHARMACOGENOMICS	3	3	0/0	0/0	Ty
BBT17OE5	2	BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	3	3	0/0	0/0	Ty

Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
Deemed to be University
with Graded Autonomy Status
[An ISO 21001 : 2018 Certified Institution]

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER - I

B.TECH Regulation 2017 Approved by the Academic Council 21.06.2017

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF ENGLISH

Subject Code : **BEN17001**	Subject Name : **TECHNICAL ENGLISH - I**	C	L	T/SLr	P/R
	Prerequisite : None	**2**	**1**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Strengthen their vocabulary in both technical and business situations
2. Get practice in functional grammar
3. Learn the effective way of corresponding with officials
4. Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages.
5. Strain learners in organized academic and professional writing in LSRW skills

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Strengthen their active and technical vocabulary
CO2	Understand functional grammar and gain proficiency in technical writing
CO3	Learn the appropriate technique of writing formal and business letters and prepare oneself to read the advertisement and prepare the resume relevantly
CO4	Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages
CO5	Focus on academic and technical writing

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				H						H		H
CO2				H						H		H
CO3				H		M			H	H		H
CO4				H					H	H		H
CO5				H					H	H		H

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Science	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BEN17001 TECHNICAL ENGLISH I 2 1 0/0 2/0

1. Vocabulary, Grammar and Usage - I (6)

Meanings of words and phrases, synonyms and antonyms – affixes: prefixes and suffixes and word formation – nominal compounds, expanding using numbers and approximation – Verb: tense, auxiliary and modal –Voice: active, passive and impersonal passive

2. Vocabulary, Grammar and Usage – II (6)

Infinitives and Gerunds – preposition, prepositional phrases, preposition + relative pronoun-'If' clause, sentences expressing 'cause and effect', 'purpose',
Instructions, suggestions and recommendations

3. Reading (6)

Questions: Wh-pattern, Yes/no questions, tag questions
Comprehension: extracting relevant information from the text, by skimming and scanning and inferring, identifying lexical and contextual meaning for specific information, identifying the topic sentence and its role in each paragraph, comprehending the passage and answering questions - Précis writing

4. Writing (6)

Adjectives: degrees of comparison
Concord: subject-verb agreement
Interpretation of tables and flowcharts: writing a paragraph based on information provided in a table using comparison and contrast, classifying the data and flowchart, describing logical steps involved in specific functions, note - making from a given passage- letter writing, formal: seeking permission to undergo practical training, letter to an editor of a newspaper complaining about civic problems and suggesting suitable solutions

5. Functional English and Practical Components (6)

Listening : Listening to stories, conversation, dialogue, speeches of famous people, and identifying the grammar components
Speaking : Scripting and enacting role plays/ narrating incidents
Reading : Review of books, articles, fiction- Extensive reading/ user manuals, pamphlets, brochures
Writing : paragraph and essay writing using academic vocabulary

Total No of Periods : 30

Text Book

1. Pushkala. R, PadmasaniKannan.S, Anuradha. V, Chandrasena Rajeswaran. M: **Quest:**A Textbook of Communication Skills, Vijay Nicole

References

1. Pushkala R, P.A.Sarada, El Dorado: A Textbook of Communication Skills, Orient Blackswan, 2014
2. PadmasaniKannan.S., Pushkala.R. : Functional English
3. Hancock, Mark, English Pronunciation in Use; Cambridge Univ. Press, 2013
4. McCarthy, Michael et.al,, English Vocabulary in Use, Advanced, Cambridge Univ. Press, 2011
5. Wren and Martin: Grammar and Composition, Chand & Co, 2006

Web Resources

1. https://learnenglish.britishcouncil.org
2. www.englishpage.com

3. www.writingcentre.uottawa.ca/hypergrammar/preposit.html
4. www.better-english.com/grammar/preposition.html
5. http://www.e-grammar.org/infinitive-gerund/
6. www.idiomsite.com/

DEPARTMENT OF MATHEMATICS

Subject Code : **BMA17002**	Subject Name :**BIO MATHEMATICS**	C	L	T/SLr	P/R
	Prerequisite : None	**4**	**3**	**1/0**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
1. Use the Basic concepts in Matrices
2. Understand the Basic concepts in Differentiation
3. Understand the Basic concepts in Integration
4. Apply the Basic concepts in Interpolation
5. Analyze the Basic concepts in Numerical Differentiation and Integration

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Find the sum, difference, product and inverse of matrixes
CO2	Find the derivative of the given function and to find the maxima / minima of the given function.
CO3	Integrate the given function by using the methods of integration and to find area under the given curve and the volume of the solid by revolution.
CO4	Evaluate the value of function at the given point and to find the polynomial expressions of the given function.
CO5	Find the differentiation of a function at the given point and to find the integration of the given function at the given point

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M			H	H		H
CO2	H	H			H	L						H
CO3	H	H			M				M	H		L
CO4	H	H			L	M			M	H		H
CO5	H	H				M			M	M		H

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Elective	Open Elective	Practical / Project	Internships / Technical Skills	Soft Skills

	√								
Approval									

BMA17002 **BIO MATHEMATICS** **4 3 1/0 0/0**

1. MATRICES (12)

Elementary operations on Matrices – Inverse of a Matrix – Solving simultaneous equations (atmost three equations with three unknowns) using Cramer's rule.

2. DIFFERENTIATION (12)

Basic concepts of Differentiation – Elementary differentiation methods – Parametric functions – Implicit function – Maxima and Minima (simple problems).

3. INTEGRATION (12)

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite Integrals – Properties of Definite Integrals – Problems on finding Area using single integrals (simple problems).

4.INTERPOLATION (12)

Interpolation: Newton's forward, Newton's backward formulae – Newton's divided differences – Lagrange's polynomial (simple problems).

5. NUMERICAL DIFFERENTIATION AND INTEGRATION (12)

Numerical differentiation with interpolation polynomials (Newton's forward and backward only) – Numerical integration by Trapezoidal and Simpson's (both $1/3^{rd}$& $3/8^{th}$) rules (simple problems).

Total no. of periods: 60

Text Books

1. Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).

2. H.K.Das, Engineering Mathematics, S.Chand Publishers
3. Veerarajan T., *Numerical Methods*, Tata McGraw Hill Publishing Co., (2007).

References

1. Shanti Narayanan, *Differential Calculus*, S.Chand& Co., New Delhi, (2005).
2. Shanti Narayanan, *Integral Calculus*, S.Chand& Co., New Delhi, (2005).
3. John Bird, *Basic Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2010).

DEPARTMENT OF PHYSICS

Subject Code : **BPH17001**	Subject Name : **ENGINEERING PHYSICS**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :
1. Outline the relation between Science, Engineering & Technology.
2. Demonstrate competency in understanding basic concepts.
3. Apply fundamental laws of Physics in Engineering & Technology.
4. To identify & solve applied Physics problems.
5. Produce and present activities associated with the course through effective technical communication

COURSE OUTCOMES (Cos) : (3 – 5)Students completing this course were able to

CO1	Demonstrate competency in understanding basic concepts.
CO2	Utilize scientific methods for formal investigations & demonstrate competency with experimental methods and verify the concept to content knowledge.
CO3	Identify and provide solutions for engineering problems.
CO4	Relate the technical concepts to day to day life and to practical situations.
CO5	Think analytically to interpret concepts.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M		L		M		
CO2	H	H	M		M	M		L		M		L
CO3	H	H	H	M		M				M		L
CO4	H	H	M		M			M				M

CO5	H	M	L	H								
H/M/L indicates strength of correlation H – High, M – Medium, L – Low												
Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills			
	√											
Approval												

DEPARTMENT OF BIOTECHNOLOGY

BPH17001 ENGINEERING PHYSICS 3 2 0/1 0/0.

1. PROPERTIES OF MATTER & ACOUSTICS (9)

Elasticity – Twisting couple on a Wire (derivation) – Shafts – Comparison of Solid and Hollow Shaft – Bending moment – Depression of a Cantilever – Determination of Young's modulus by Depression of a Cantilever – Uniform and non uniform bending (Experiment) – I form of Girders.
Viscosity – Definitions – Lubrication – Properties & Types of Lubricant. Acoustics of Buildings – Reverberation – Reverberation time –Sabine`s formula for Reverberation Time – Absorption Coefficient and its Determination – Factors affecting Acoustics of Buildings and its Remedial Measures.

2. THERMAL PHYSICS (9)

Thermal conduction – Thermal Expansion – Expansion joints – Bimetallic strips – Thermal conductivity (k) – Lee's Disc method (theory and experiment) – Radial flow of heat –Thermal conductivity of Glass – Thermal conductivity of Rubber Tube – Flow of heat through Compound Media – Thermal Insulation of buildings – Thermal radiation – Concept of Black body radiation – Fundamentals of Low Temperature Physics.

3. ULTRASONICS AND ITS APPLICATIONS (9)

Properties & Production of Ultrosonics – Piezoelectric method – Magnetostriction method – Acoustic Grating – Industrial Applications – Ultrasonic flaw detection (Block Diagram) – Medical Application: Velocity Blood Flow Meter – PhonoCardiography – Ultrasound imaging – Hazards and safety of Ultrasound – NDT of Materials using Ultrasonics.

4. LASER & ITS APPLICATIONS (9)

Nature of Light – Laser Principle & Characteristics–Ruby laser – Nd- YAG Laser – He-Ne Laser – Co_2 Laser – Semiconductor laser – Homo junction & Hetero Junction Laser – Engineering applications – Holography, Surveying – Industrial applications – Cutting, Welding – Medical applications – Surgery

5. FIBER OPTIC COMMUNICATION (9)

Total Internal Reflection – Propagation of Light in Optical Fibres – Numerical aperture and Acceptance Angle – Types of Optical Fibres (material, refractive index, mode) – Fibre Optical Communication system (Block diagram) – Attenuation–Transmitter, Receiver, Dispersion, Modulation/Demodulation Advantages of Fibre Optical Communication System – IMT, PMT, Wavelength Modulated & Polarization Modulated Sensors – Endoscope Applications.

Total No. of Periods : 45

Text Books

1. M. Arumugam, "Engineering Physics", Anuradha Publication (2004)
2. Dr. Senthil Kumar "Engineering Physics I" VRB Publishers (2016)
3. N.S.Shubhashree&R.Murugesan., "Engineering Physics", Sreelakhsmi Publishers(2008)

References

4. K. Gaur & S.L. Gupta, "Engineering. Physics", Dhanpat Raj & Sons, VI Edition, (1988)
5. Palanisamy, P.K., "Engineering Physics", Scitech Publications (P) Ltd., (2006)

DEPARTMENT OF CHEMISTRY

Subject Code : **BCH17001**	Subject Name : **ENGINEERING CHEMISTRY – I**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Providing an insight into basic concepts of chemical thermodynamics.
2. To create awareness about the water quality parameters, water analysis and softening of water from industrial perspective.
3. Imparting fundamentals of emf, storage and fuel cells.
4. Creating awareness about corrosion and its control methods.
5. Introducing modern materials such as composites along with basic concepts of polymer chemistry and plastics.

COURSE OUTCOMES (Cos) : (3 – 5)

CO1	Gain a clear understanding of the basics of chemical thermodynamics which include concepts such as Enthalpy, Entropy and Free energy.
CO2	Obtain an overall idea of Water quality parameters, Boiler requirements, problems, Water softening and Domestic Water treatment.
CO3	Improving the basic knowledge in electrical conductance and emf and also understand the chemical principles of storage devices.
CO4	Observe the information about corrosion and understand the mechanisms of corrosion and the methods of corrosion control.
CO5	Articulate the science of polymers and composites**.**

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M										M
CO2	M	L	M	L		L	H					M
CO3	L	M	L				L					L
CO4	M		L	L								L
CO5	M		L									M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

DEPARTMENT OF BIOTECHNOLOGY

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

BCH17001 ENGINEERING CHEMISTRY – I 3 2 0/1 0/0

1. CHEMICAL THERMODYNAMICS (8)

Introduction, Terminology in thermodynamics –System, Surrounding, State and Path functions, Extensive and intensive properties. Laws of thermodynamics – I and II laws-Need for the II law. Enthalpy, Entropy, Gibbs free energy, Helmholtz free energy - Spontaneity and its criteria. Maxwell relations, Gibbs -Helmholtz equation (relating E & A) and (relating H & G), Van't Hoff equations.

2.TECHNOLOGYOF WATER (9)

Water quality parameters – Definition and expression. Analysis of water – alkalinity, hardness and its determination (EDTA method only). Boiler feed water and Boiler troubles-Scales and sludges, Caustic embrittlement, Priming and Foaming and Boiler corrosion. Water softening processes – Internal and external conditioning – Lime soda, Zeolite, Demineralisation methods. Desalination processes-RO and Electrodialysis .Domestic water treatment.

3. ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES **(**10)

Conductance – Types of conductance and its Measurement. Electrochemical cells – Electrodes and electrode potential, Nernst equation – EMF measurement and its applications. Types of electrodes- Reference electrodes- Standard hydrogen electrode- Saturated calomel electrode-Quinhydrone electrode – Determination of P^H using these electrodes.

Reversible and irreversible cells– Fuel cells- H_2–O_2 fuel cell, Batteries-Lead storage battery,Nickel– Cadmium and Lithium-Battery.

4. CORROSION AND PROTECTIVE COATING (9)

Introduction–Causes of Corrosion–Consequences- Factors affecting corrosion. Theories of corrosion-Chemical corrosion and Electrochemical corrosion. Methods ofcorrosion control – corrosion inhibitors, Sacrificial anode and Impressed current cathodic protection.

Protective coatings- Metallic coatings- Chemical conversion coatings-paints-Constituents and functions.

5.POLYMERS AND COMPOSITES (9)

Monomers – Functionality – Degree of polymerization-Tacticity.Polymers – Classification, Conducting Polymers,Biodegradable polymers- Properties and applications.Plastics – Thermoplastics and thermosetting plastics,Compounding of plastics – Compression moulding, injection moulding and extrusion processes.

Polymer composites-introduction-Types of composites-particle reinforced-fiber reinforced-structural composites-examples. Matrix materials, reinforcement materials-Kevlar, Polyamides, fibers, glass, carbon fibers, ceramics and metals .

Total number of periods : 45

Textbooks

1. S.Nanjundan & C.SreekuttanUnnithan, "Applied Chemistry", Sreelakshmi Publications, (2007)
2. Dr.R.Sivakumar and Dr.N.Sivakumar" Engineering Chemistry" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.

References

1. P.C. Jain & Monika Jain, "Engineering Chemistry", Dhanpat Rai publishing Co., (Ltd.) (2013).
2. J. C. Kuriacose & J. Rajaram, "Chemistry in Engineering & Technology", Tata Mc Graw Hill (1996).
3. B.R.Puri, L.R.Sharma & M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Subject Code : **BES17001**	Subject Name : **BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Understand the concepts of circuit elements, circuit laws and coupled circuits.
2. Acquire knowledge on conventional &non conventional energy production.
3. Gain information on measurement of electrical parameters.
4. Identify basic theoretical principles behind the working of modern electronic gadgets.
5. Demonstrate digital electronic circuits and assemble simple devices.

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Students understand Fundamental laws and theorems and their practical applications
CO2	Predict the behavior of different electric and magnetic Circuits.
CO3	Identify conventional and Non-conventional Electrical power Generation, Transmission and Distribution.
CO4	Identify & Apply schematic symbols and understand the working principles of electronic devices
CO5	Analyze basics of digital electronics and solving problems and design combinational circuits

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H							M	L
CO2	H	H	H	M	M		M				M	
CO3	H	M	H	M	H		M		M			L
CO4	H	M		M			M				M	L
CO5	H	M	H	M	H				M		M	L

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
		√							

Approval	

BES17001 BASIC ELECTRICAL & ELECTRONICS ENGINEERING 3 2 0/1 0/0

1. ELECTRIC CIRCUITS (9)

Electrical Quantities – Ohms Law – Kirchhoff's Law – Series and Parallel Connections – Current Division and Voltage Division Rule - Source Transformation – Wye (Y) – Delta (Δ) , Delta (Δ) – Wye (Y) Transformation – Rectangular to Polar and Polar to Rectangular.

2. MACHINES & MEASURING INSTRUMENTS (9)

Construction & Principle of Operation of DC motor & DC Generator – EMF equation of Generator – Torque Equation of Motor – Construction & Principle of operation of a Transformer – PMMC – Moving Iron types of meter – Single Phase Induction Type Energy Meter.

3. BASICS OF POWER SYSTEM (9)

Generation of Electric Power (Thermal, Hydro, Wind and Solar) – Transmission & Distribution of Electric Power – Types of Transmission & Distribution Schemes – Representation of Substation.

4. ELECTRON DEVICES (9)

Passive Circuit Components-Classification of Semiconductor-PN Junction Diode-Zener diode- Construction and Working Principle –Applications--BJT-Types of configuration-JFET.

5. DIGITAL SYSTEM (9)

Number System – Binary, Decimal, Octal, Hexadecimal – Binary Addition Subtraction, Multiplication & Division– Boolean Algebra – Reduction of Boolean Expressions – Logic Gates - De-Morgan's Theorem , Adder – Subractor.

Total no of Periods : 45

Text Books

1. D P Kothari, I J Nagrath, Basic Electrical Engineering, Second Edition, , Tata McGraw-Hill Publisher
2. A Course In Electrical And Electronic Measurements And Instrumentation,A.K. Sawhney, publisher DHANPAT RAI&CO
3. Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization,B.L.Theraja, A.K.Theraja, publisher S.CHAND
4. Morris Mano, M. (2002) Digital Logic and Computer Design. Prentice Hall of India
5. Millman and Halkias1991, Electronic Devices and Circuits , Tata McGraw Hill,

References

1. R.Muthusubramanian, S.Salivahanan, K A Muraleedharan, Basic Electrical, Electronics And Computer Engineering, Second Edition, ,Tata McGraw-Hill publisher.

DEPARTMENT OF BIOTECHNOLOGY

DEPARMENT OF MECHANICAL ENGINEERING

Subject Code : **BES17002**	Subject Name : **BASIC MECHANICAL & CIVIL ENGINEERING**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Learn Basics of Internal Combustion Engines, power plants and boilers
2. Demonstrate How metals are formed, joined, using machining operations Lathe, Milling and Drilling machines
3. To identify & solve problems in Engineering Mechanics
4. Learn basics of Building materials and construction
5. Know the basic process of concrete, types of masonry Construction of Roads , Railways, Bridges and Dams

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Demonstrate the working principles of power plants, IC Engines and boilers..
CO2	Utilize the concept of metals forming, joining process and apply in suitable machining process
CO3	Identify and provide solutions for problems in engineering mechanics
CO4	Utilize the concept of Building materials and construction able to perform concrete mix and masonry types
CO5	Demonstrate how Roads, Railways, dams, Bridges have been constructed

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H					M		H	H	H		H
CO2	H				L	M		M	M	M		M
CO3	H	H			L	L		M	M	M		M
CO4	H				L	L			M	M		M
CO5	H				L	L		M	M	M		M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills

		√							
Approval									

BES17002 BASIC MECHANICAL & CIVIL ENGINEERING 3 2 0/1 0/0

UNIT- I : THERMAL ENGINEERING (9)

Classification of internal combustion engine – two stroke, four stroke petrol and diesel engines. Classification of Boilers – Cochran boiler – Locomotive boilers – Power plant classification – Working of Thermal and Nuclear power plant.

UNIT- II : MANUFACTURING PROCESS (13)

Metal forming processes – Rolling, forging, drawing, extrusion and sheet metal operations- fundamentals only. Metal Joining processes – Welding - arc and gas welding, Soldering and Brazing. Casting process – Patterns - Moulding tools - Types of moulding - Preparation of green sand mould -Operation of Cupola furnace.

Basics of metal cutting operations – Working of lathe- parts-Operations performed. Drilling machine – Classification – Radial drilling machine - Twist drill nomenclature.

UNIT- III : MECHANICS (9)

Stresses and Strains – Definition – Relationship – Elastic modulus – Centre of gravity – Moment of Inertia – Problems. (Simple Problems Only).

UNIT- IV : BUILDING MATERIALS AND CONSTRUCTION (7)

Materials: Brick - Types of Bricks - Test on bricks - Cement – Types, Properties and uses of cement – Steel - Properties and its uses – Ply wood and Plastics.

Construction: Mortar – Ingredients – Uses – Plastering - Types of mortar - Preparation – Uses – Concrete – Types – Grades – Uses – Curing – Introduction to Building Components (foundation to roof) – Masonry – Types of masonry (Bricks & Stones)

UNIT- V : ROADS, RAILWAYS, BRIDGES & DAMS (7)

Roads – Classification of roads – Components in roads – Railways -Components of permanent way and their function – Bridges – Components of bridges – Dams – Purpose of dams – Types of dams.

Total No. of Periods : 45

Text books

1. S. Bhaskar, S. Sellappan, H.N.Sreekanth,, (2002), "*Basic Engineering*" –Hi-Tech Publications
2. K. Venugopal, V. Prabhu Raja, (2013-14), "*Basic Mechanical Engineering*", Anuradha Publications.
3. K.V. Natarajan (2000), *Basic Civil Engineering*,Dhanalakshmi Publishers
4. S.C. Sharma(2002),*Basic Civil Engineering*,Dhanpat Raj Publications

References

1. PR.SL. Somasundaram, (2002), "*Basic Mechanical Engineering*" –, Vikas Publications.
2. S.C. Rangawala(2002), *Building Material and Construction*, S. Chand Publisher

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

Subject Code : **BES17ET1**	Subject Name : **BASIC ENGINEERING GRAPHICS**	C	L	T/SLr	P/R
	Prerequisite : None	**2**	**1**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Learn to know what kind of pencils to be used to sketch lines, numbers, Letters and Dimensioning in drawing sheet.
2. Draw Projection of points, line, planes and solids using Drafters
3. To identify the angle of projection and development of surfaces, isometric projection and Orthographic projection
4. Know the basics of elevation and plan of building.
5. Learn the basics of Drafting using AutoCAD Software

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Utilize the concept of Engineering Graphics Techniques to draft letters, Numbers, Dimensioning in Indian Standards
CO2	Demonstrate the drafting practice visualization and projection skills useful for conveying ideas in engineering applications.
CO3	Identify basic sketching techniques of engineering equipments
CO4	Demonstrate the projections of Points, Lines, Planes and Solids.
CO5	Draw the sectional view of simple buildings and utilize Auto CAD Software.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	M			H	H		H
CO2	H	H	H	M	M	M			H	H		H
CO3	H	H	H	L		M			M	M		M
CO4	H	H	M	M		H		M	H	H		H
CO5	H	H	H	M	H	L		M	H	H		H

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills

							√		
Approval									

BES17ET1 **BASIC ENGINEERING GRAPHICS** **2 1 0/0 2/0**

CONCEPTS AND CONVENTIONS (Not for examination) (3)

Introduction to drawing, importance and areas of applications – BIS standards – IS: 10711 – 2001 : Technical products Documentation – Size and layout of drawing sheets – IS 9606 – 2001: Technical products Documentation – Lettering – IS 10714 & SP 46 – 2003: Dimensioning of Technical Drawings – IS : 15021 – 2001 : Technical drawings – Projections Methods – drawing Instruments, Lettering Practice – Line types and dimensioning – Border lines, lines title blocks Construction of polygons – conic sections – Ellipse, Parabola, Hyperbola and cyloids.

UNIT- I : PROJECTION OF POINTS, LINES AND PLANE SURFACES (6)

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – projection of polygonal surface and circular lamina in simple position only.

UNIT- II : PROJECTION OF SOLIDS (6)

Projection of simple solids like prism, pyramid, cylinder and cone in simple position

Sectioning of above solids in simple vertical position by cutting plane inclined to one reference plane and perpendicular to the other.

UNIT- III : DEVELOPMMENT OF SURFACES AND ISOMETRIC PROJECTION (6)

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders, and cones.

Principles of isometric projection – isometric scale – isometric projections of simple solids, like prisms pyramids, cylinders and cones.

UNIT- IV : ORTHOGRAPHICS PROJECTIONS (6)

Orthographic projection of simple machine parts – missing views

BUILDING DRAWING

Building components – front, Top and sectional view of a security shed.

UNIT- V : COMPUTER AIDED DRAFTING (3)

Introduction to CAD – Advantages of CAD – Practice of basic commands – Creation of simple components drawing using CAD software.

Total No. of periods:30

Note:First angle projection to be followed.

Text Books

1. Bhatt, N.D. and Panchal, V.M. (2014) Engineering Drawing Charotar Publishing House
2. Gopalakrishnan, K.R. (2014) Engineering Drawing (Vol.I& II Combined) Subhas Stores, Bangalore.

References

1. Natarajan, K.V (2014) A Text Book of Engineering Graphics, DhanalakshmiPublisheres, Chennai
2. Venugopal, K and Prabhu Raja, V. (2010) Engineering Graphics, New Age International (P) Limited

Special Points applicable to University examinations on Engineering Graphics

1. There will be five questions, each of either or type covering all UNIT-s of the syllabus
2. All questions will carry equal marks of 20 each making a total of 100
3. The answer paper shall consists of drawing sheets of A2 size only. The students will be permitted to use appropriate scale to fit solution within A2 size.

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with Graded Autonomy Status
(An ISO 21001 : 2018 Certified Institution)

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF PHYSICS

Subject Code : **BPH17L01**	Subject Name : **ENGINEERING PHYSICS LAB**	C	L	T/SLr	P/R
	Prerequisite : None	**1**	**0**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Demonstrate an ability to make physical measurements & understand the limits of precision in measurements.
2. Display the ability to measure properties of variety of electrical, mechanical, optical systems.

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Recognize the correctness and precision in the results of measurements.
CO2	Construct and compare the properties of variety of electrical, mechanical, electronic and optical systems.
CO3	Practice the handling of Electrical, Electronic, Optical & Mechanical Equipments
CO4	Identify and compare the theoretical and practical usage of various instruments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	M							
CO2	H	M	M	H						M		
CO3	H	M	M	H	M				M	M		M
CO4	H	H	M	M	H				M			L

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BPH17L01	**ENGINEERING PHYSICS LAB**	**1**	**0**	**0/0**	**2/0**

LIST OF EXPERIMENTS (Any Seven)

1. Torsional Pendulum Without Masses–Determination of Rigidity Modulus and Moment of Inertia
2. Torsional Pendulum With Masses–Determination of Rigidity Modulus and Moment of Inertia
3. Non Uniform Bending – Determination of Young`s Modulus
4. Uniform Bending – Determination of Young`s Modulus
5. Poiseuille`s Method - Determination of Coefficient of Viscosity of a given liquid
6. Lee's Disc – Determination of Thermal Conductivity of Bad Conductor
7. Spectrometer – Determination of Refractive Index of a Prism
8. Laser Grating – Determination of Wavelength of a given Source
9. Spectrometer –Determination of Wavelength of Mercury Spectrum using Grating
10. Transistor Characteristics.

DEPARTMENT OF CHEMISTRY

Subject Code : **BCH17L01**	Subject Name :**ENGINEERING CHEMISTRY LAB**	C	L	T/SLr	P/R
	Prerequisite : None	**1**	**0**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. To familiarize the students in the determination of water quality parameters
2. To help learners measure conductivity and EMF using electrical equipment.
3. To create awareness about corrosion.
4. To determine the essential parameters of polymers

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Awareness of water quality parameters and its determination.
CO2	Familiarizing the conductometric titration method.
CO3	Ability to measure EMF and perform potentiometric titrations.
CO4	Measuring the Molecular weight of macromolecules
CO5	Gaining awareness about corrosion.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	M	M							L
CO2	M	H		L	M				L			
CO3	L	M		L					L			
CO4	M	M		L					L			
CO5	L	M	L	L								M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills

			Sciences					Skills	
							√		
Approval									

BCH17L01 **ENGINEERING CHEMISTRY LAB** **1 0 0/0 2/0**

LIST OF EXPERIMENTS (Any Seven)

(1) Estimation of temporary, permanent and total hardness of water.

(2) Determination of type and extent of alkalinity in water.

(3) Estimation of dissolved oxygen in a water sample.

(4) Conductometric titration of strong acid vs. strong base

(5) Conductometric precipitation titration using barium chloride and sodium sulphate.

(6) Determination of Equivalent conductance of strong electrolyte at infinite dilution.

(7) Determination of single electrode potential.

(8) Estimation of Fe^{2+}ion by potentiometry.

(9) Determination of Molecular Weight and Degree of Polymerisation of Polymer by viscometry.

(10) Determination of rate of corrosion by weight loss method.

DEPARTMENT OF ENGINEERING SCIENCES

Subject Code : **BES17L01**	Subject Name :**BASIC ENGINEERING WORKSHOP**	C	L	T/SLr	P/R
	Prerequisite : None	**1**	**0**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Familiarize the plumbing tools, fittings, carpentry tools, etc.
2. Identify basic electrical wiring and measurement of electrical quantities.
3. Identify Electronic components ,logic gates and soldering process
4. Display simple fabrication techniques
5. Execute a project independently and make a working model

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Demonstrate fitting tools and carpentry tools, & Perform the process of Filing, Chipping, Cutting.
CO2	Perform the process of fabrication of tray, cones and funnels, Tee Halving Cross, Lap Joint Martise& Joints
CO3	Demonstrate various types of wirings and other equipments.
CO4	Measure fundamental parameters using the electronic instruments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M			L	M			L
CO2	H		H	L	M			L	L			
CO3	H		M	L				L	L			
CO4	H	H	M	L				L	L			M
CO5												

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Scienc	Humanities & Social	Program core	Program Elective	Open Elective	Practical / Project	Internships / Technical	Soft Skills

		es	Sciences		s	s		Skills	
							√		
Approval									

BES17L01 **BASIC ENGINEERING WORKSHOP** **1 0 0/0 2/0.**

MEP PRACTICE

1. **FITTING :**
   Study of fitting tools and Equipments – Practicing, filing, chipping and cutting – making V-joints, half round joint, square cutting and dovetail joints.

2. **CARPENTRY:**
   Introduction – Types of wood – Tools – Carpentry processes – Joints – Planning practice – Tee Halving Joint – Cross Lap Joint – Maritse and Tenon Joint – Dovetail Joint

3. **SHEET METAL:**
   Study of tools and equipments – Fabrication of tray, cones and funnels.

CIVIL ENGINEERING PRACTICE

1. Study of Surveying and its equipments
2. Preparation of plumbing line sketches for water supply and sewage lines
3. Basic pipe connection using valves, laps, couplings, unions, reduces and elbows in house hold fittings

ELECTRICAL ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR
2. Soldering practice – Components Devices and Circuits – Using general purpose PCB
3. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
4. Fluorescent lamp wiring.
5. Stair case wiring

DEPARTMENT OF BIOTECHNOLOGY

ELECTRONIC ENGINEERING PRACTICE

1. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
2. Measurement of energy using single phase energy meter.
3. Measurement of resistance to earth of an electrical equipment.

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DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

Subject Code : **BES17ET2**	Subject Name : **C PROGRAMMING AND LAB**	C	L	T/SLr	P/R
	Prerequisite : None	**2**	**1**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Outline the basics of C Language.
2. Apply fundamentals in C programming.
3. Produce and present activities associated with the course.

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course were able to

CO1	Acquire knowledge how to write and execute c programs
CO2	Understand the fundamental expression and statements of C Language.
CO3	Work with arrays, functions, pointers, structures, Strings and Files in C.
CO4	Identify and provide solutions for engineering problems in C programming

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M		H	M			H
CO2	H	M			H	M		M	H			M
CO3	H			H		M		M	H			M
CO4	H			M		M		H	M			M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BES17ET2 **C PROGRAMMING AND LAB** **2 1 0/0 2/0**

1. INTRODUCTION (6)

Fundamentals, C Character set, Identifiers and Keywords, Data Types, Variables and Constants, Structure of a C Program, Executing a C Program.

2.EXPRESSION AND STATEMENT (6)

Operators, Types-Complex and Imaginary, Looping Statement-For, While, Do, Break, continue, Decision Statement-If, If else, Nested if, Switching Statement, Conditional Operator.

3.ARRAYS AND FUNCTIONS (6)

Defining an Array, Using Array elements as counters, Generate Fibonacci number, Generate Prime Numbers, Initializing Arrays, Multidimensional Arrays, Defining a Function, Function call -types of Function calls -Function pass by value -Function pass by reference, Write a Program in Recursive Function.

4. STRUCTURES AND POINTERS (6)

Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables, Understanding Pointers -Introduction -Syntax of Pointer.

5. STRINGS AND FILE HANDLING (6)

Strings -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard, Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File- Problem solving in C

Total No of Periods: 30

1. **www.spoken-tutorials.org**
2. **http://www.learn-c.org/**

Reference :

1. Stephen G. Kochen“ Programming in C- A complete introduction to the C Programming Language. Third Edition, Sams Publishing -2004
2. Ajay Mital, “ Programming in C: A Practical Approach”, Pearson Publication-2010

List of Programs

1. Write a program to check 'a' is greater than 'b' or less than 'b' Hint: use if statement.
2. Write another program to check which value is greater 'a', 'b' or 'c'. Hint: use else-if statement. (Take values of a, b, c as user inputs)
3. Write a Program to find the sum of the series : $x + X^3/3! + X^5/5! + \ldots\ldots\ldots\ldots\ldots X^n/n!$
4. Write a C Program to solve a Quadratic Equation by taking input from Keyboard
5. Write a C Program to arrange 20 numbers in ascending and descending Order. Input the Numbers from Keyboard
6. Write a C Program to Multiply a 3 x 3 Matrix with input of members from Keyboard
7. Write a program that takes marks of three students as input. Compare the marks to see which student has scored the highest. Check also if two or more students have scored equal marks.
8. Write a program to display records of an employee. Like name, address, designation, salary.
9. Write a C program, declare a variable and a pointer. Store the address of the variable in the pointer. Print the value of the pointer.
10. Write a C program to concatenate String 'best' and String 'bus'. Hint: strcat(char str1, char str2);

11. Explore the other functions in string library.
12. Write a program to create a file TEST. Write your name and address in the file TEST. Then display it on the console using C program.

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DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF ENGINEERING SCIENCES

Subject Code : **BES17ET3**	Subject Name : **ENTREPRENEURIAL SKILL DEVELOPMENT & PROJECT LAB**	C	L	T/SLr	P/R
	Prerequisite : None	**1**	**0**	**0/0**	**2/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Understand how entrepreneurship Education transforms individuals into successful leaders.
2. Identify individual potential &Shape career dreams
3. Understand difference between ideas & opportunities
4. Understand the "flow" & create Entrepreneurial CV.
5. Identify components & create action plan.
6. Use brainstorming in a group to generate ideas.

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Develop a Business plan & improve ability to recognize business opportunity
CO2	Do a self analysis to build a entrepreneurial career.
CO3	Articulate an effective elevator pitch.
CO4	Analyze the local market environment & demonstrate the ability to find an attractive market
C05	Apply an ethical understanding & perspective to change opportunities to business situations

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M	M	H	M	M	M		M	M	M	L
CO2	H	M		H	M	H	M	H	H	H	M	M
CO3		M	M	M		H		H	H	H		
CO4		H	M	M	M	M		H	M	M	H	
CO5		M	M	H	M	M	H	H	M	M	H	L

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
							√		

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BES17ET3 ENTREPRENEURIAL SKILL DEVELOPMENT & PROJECT LAB 1 0 0/0 2/0

1. CHARACTERISTICS OF A SUCCESSFUL ENTREPRENEUR

Introduction to entrepreneurship education – Myths about entrepreneurship – How has entrepreneurship changed the country – Dream it. Do it - Idea planes - Some success stories – Global Legends – Identify your own heroes – entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

2. DESIGN THINKING & RISK MANAGEMENT

Introduction to Design thinking – Myth busters – Design thinking Process - Customer profiling – Wowing your customer – Personal selling – concept & process – show & tell concept – Introduction to the concept of Elevator Pitch - Introduction to risk taking & Resilience – Managing risks (Learning from failures, Myth Buster) – Understanding risks through risk takers – Why do I do? – what do I do ?

3.IDEA GENERATION & EVALUATION

Introduction – Finding your flow – Entrepreneurial CV – your draft action plan - D.I.S.R.U.P.T - A model for ideation – Let's ID8 – Mind mapping for ideas – build your own idea bank – Concept of Decision matrix & paired comparison analysis – 5Q framework.

4. ENTREPRENEURIAL OUTLOOK & CUSTOMER DISCOVERY

Effectuation – Start with your means – Segmentation & targeting – Niche marketing – Find your Niche – Drawing & mapping the consumption chain - outcome driven innovation – This is my customer

5. VALUE PROPOSITION& CAP STONE PROJECT PRESENTATION

Introduction – Value proposition design – customer segment – validation exercise – value propositions & assessing fit – Refine your value proposition – Blue ocean strategy - What is prototyping – Design your experiment – Design your MVP – Learning cards & Capstone Presentation.

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DEPARTMENT OF BIOTECHNOLOGY

SEMESTER - II

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DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF ENGLISH

Subject Code : BEN17002	Subject Name : TECHNICAL ENGLISH - II	C	L	T/SLr	P/R
	Prerequisite : None	2	1	0/0	2/0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. strengthen the academic and interpersonal advanced vocabulary
2. strengthen their writing skill such as summarizing, describing and report writing
3. learn to keep the simple conversations in day to day life
4. get to know certain life skills such as marketing, advertising and do presentation
5 improve the reading skill with comprehension

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	strengthen their active vocabulary and appropriate language usage through reading poems, stories, texts, newspapers, magazines and research articles
CO2	use appropriate technical vocabulary in interpreting data
CO3	engage effectively in role-play, dialogue, conversation and interviews
CO4	equip them for effective interaction with people in all situations both academic and professional
CO5	learn English language as a ‘life skill’ and prepare for placement interviews

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				H						H		H
CO2				H						H		H
CO3				H		M			H	H		H
CO4				H					H	H		H
CO5				H					H	H		H

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
			√						

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BEN17002 **TECHNICAL ENGLISH II** **2 1 0/0 2/0**

Unit I Vocabulary, Grammar and Usage – I (6)

Verbal analogy – picking out the odd one from a series –finding one word substitute – paragraph writing: using discourse markers, defining / describing an object / device / instrument / machine using topic sentence and its role, unity, coherence and use of cohesive expressionsEssay writing with due emphasis on features such as topical sentence, unity, coherence and cohesive devices

UnitII Vocabulary, Grammar and Usage – II (6)

Cloze – completion of sentences suitably, phrases and idioms, homophones – collocation -
Techniques of formatting and drafting reports: writing newspaper reports on accidents, thefts and festivals

Unit III Reading (6)

Correcting errors in sentencesEditing a passage (correcting the mistakes in grammar, spelling and punctuation) - interpreting pie and bar charts

Unit IV Writing (6)

Register: formal and informal – using ellipses in dialogues- framing dialogues-Email: Job Application, Resume

Unit V Functional English and Practical Components (6)

Listening: Media Advertisement

Speaking: oral practice- activities related to professional skills (e.g. Marketing, advertising etc.), role play activities using different speech functions (persuasion, negotiation, giving directions and guidance), conversational etiquette (politeness, strategies, turn-taking, body language).

Reading: reading newspaper/ magazine articles for gathering information

Writing: Note-making from newspaper and magazine articles- follow BEC method

Writing and speaking dialogue writing followed by role play in different situations such as asking permission, requesting and instructing, introducing oneself – activities based on BEC

Total No of Periods :30

Text Book

1. Pushkala. R, PadmasaniKannan.S ,Anuradha. V,ChandrasenaRajeswaran.M Quest : A Textbook of ommunication
   Skills, Vijay Nicole,

References

1. Pushkala R, P.A.Sarada, El Dorado: A Textbook of Communication Skills, Orient Blackswan, 2014
2. PadmasaniKannan.S., Pushkala.R. : Functional English
3. Hancock, Mark, English Pronunciation in Use; Cambridge Univ. Press, 2013
4. McCarthy, Michael et.al,, English Vocabulary in Use, Advanced, Cambridge Univ. Press, 2011
5. Wren and Martin: Grammar and Composition, Chand & Co, 2006

Web Sources

1. https://learnenglish.britishcouncil.org
2. www.englishpage.com
3. www.writingcentre.uottawa.ca/hypergrammar/preposit.html
4. www.better-english.com/grammar/preposition.html
5. http://www.e-grammar.org/infinitive-gerund/
6. www.idiomsite.com/

DEPARTMENT OF MATHEMATICS

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code : BMA17003	Subject Name : MATHEMATICS – II	C	L	T/SLr	P/R
	Prerequisite : None	4	3	1/0	0/0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Understand the Basic concepts in Integration
2. Identify the Basic concepts in Multiple integrals
3. Use the Basic concepts in Ordinary Differential equations
4. Apply the Basic concepts of Analytical Geometry
5. Analyze the Basic concepts of Vector Calculus

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	Integrate given function by using methods of integration and to find the area under curve and the volume of a solid by revaluation.
CO2	Evaluate the multiple integrals / area /volume and to change the order of integration.
CO3	Solve the ordinary differential equation and to solve Eulers differential equation.
CO4	Find the equation of planes, lines and sphere and to find the shortest distance between to skew lines.
CO5	Find the gradient, maximum directional derivative and work done by a force and to verify Green/ Stokes/ Gauss divergence theorem

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H			M	M			M	M		H
CO2	H	H			M	H			H	H		M
CO3	H	H			M	H			H	H		M
CO4	H	H			L	M			M	H		M
CO5	H	H			M	M			M	H		M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BMA17003

MATHEMATICS – II **4 3 1/0 0/0**

1. INTEGRATION (12)

Basic concepts of Integration – Methods of Integration– Integration by substitution – Integration by parts – Definite integrals– Properties of definite integrals – Problems on finding Area and Volume using single integrals (simple problems).

2. MULTIPLE INTEGRALS **(**12)

Double integral in Cartesian and Polar Co-ordinates – Change of order of integration – Triple integral in Cartesian Co-ordinates – Spherical Polar Co-ordinates – Change of variables (simple problems).

3.ORDINARY DIFFERENTIAL EQUATIONS (12)

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form: e^{ax}, x^n, Sin ax, Cos ax, $e^{ax}f(x)$, x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form) (simple problems).

4.THREE DIMENSIONAL ANALYTICAL GEOMETRY (12)

Direction Cosines and Ratios – Equation of a straight line – Angle between two lines – Equation of a plane – Co-planar lines – Shortest distance between skew lines – Sphere – Tangent plane.

5. VECTOR CALCULUS (12)

Scalar and Vector functions – Differentiation – Gradient, Divergence and Curl – Directional derivatives – Irrotational and Solenoidal fields– Line, Surface and Volume integrals – Green's, Stoke's and Gauss divergence theorems (statement only) – Verification.

Total no. of periods : 60

Textbooks

1. Kreyszig E., *Advanced Engineering Mathematics (10th ed.)*, John Wiley & Sons, (2011).
2. Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).

References

1. Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
2. John Bird, *Basic Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2010).
3. P.Kandasamy, K.Thilagavathy and K. Gunavathy, *Engineering Mathematics Vol. I (4th Revised ed.)*, S.Chand& Co.,

Publishers, New Delhi (2000).

4. John Bird, *Higher Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2006).

DEPARTMENT OF BIOTECHNOLOGY

DEPARTMENT OF MATHEMATICS

Subject Code : **BMA17004**	Subject Name : **BIO STATISTICS**	C	L	T/SLr	P/R
	Prerequisite : None	**4**	**3**	**1/0**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Understand the Basic concepts in Statistics
2. Use the Basic concepts in Correlation
3. Understand the Basic concepts in Probability theory
4. Apply the Basic concepts in Testing of Hypothesis
5. Analyze the Basic concepts in Design of Experiments

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Find the measures of central tendency and to find the measures of dispersion.
CO2	Evaluate the moments measures of skewness and kurtorsls and to evaluate correlation and regression.
CO3	Apply knowledge and concepts in finding the probability of a random variable and use addition and multiplication laws of Probability
CO4	Have ability to test and to give conclusion in testing of hypothesis.
CO5	Analyze and interpret results through one way and two way ANOVA

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H				H			M		M	M
CO2	H	H				H			L			H
CO3	H	H	L		L	M			L		L	H
CO4	H	H	L		L	M			M			H
CO5	H	H	H	M					M			H

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills

	√								
Approval									

BMA17004 **BIO STATISTICS** **4 3 1/0 0/0**

1. BASICS OF STATISTICS (12)

Variables – Uni-variate Data – Frequency Distribution – Measures of Central Tendency – Mean –Median –Mode – Quartiles – Measures of Dispersion – The Range – Quartile Deviation –Standard Deviation.

2. CORRELATION (12)

Measures of Skewness& Kurtosis – Bi-variate data – Correlation & Regression.

3. PROBABILITY AND RANDOM VARIABLE (12)

Definition of Random Experiment - Sample Space – Events: Mutually exclusive events - Exhaustive events - Dependent events and Independent events - Mathematical and Statistical definition of probability - Theorems of addition and multiplication laws of Probability (Without proof) - Conditional probability (Simple problems).

4. SAMPLING (12)

Tests of Significance – Large Sample Tests – Mean – Proportions – Small Sample Tests – t, F & Chi-square Tests – Independence of Attributes – Goodness of Fit.

5. DESIGN OF EXPERIMENTS (12)

Analysis of Variance: One Way & Two-Way Classification – Design of Experiments – Randomized Block Design – Completely Randomized Block Design – Latin Square Design.

Total no. of Periods : 60

Text books

1. Gupta S.C, Kapoor V.K, *Fundamentals of Mathematical Statistics*, S.Chand& Co, New Delhi (2003).
2. Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).

References

1. Gupta S.P, *Statistical Methods*, S.Chand& Co., New Delhi (2003).
2. Singaravelu, *Probability and Random Processes*, Meenakshi Agency, (2017).
3. Richard Johnson A., *Miller & Freund's Probability and statistics for Engineers (9th ed)*, Prentice Hall of India, (2016).

DEPARTMENT OF PHYSICS

Subject Code : **BPH17002**	Subject Name : **MATERIAL SCIENCE**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Design, conduct experiment and analyze data.
2. Develop a Scientific attitude at micro and nano scale of materials
3. Understand the concepts of Modern Physics
4. Apply the science of materials to Engineering & Technology

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	Demonstrate skills necessary for conducting research related to content knowledge and laboratory skills.
CO2	Apply knowledge and concepts in advanced materials and devices.
CO3	Acquired Analytical, Mathematical skills for solving engineering problems.
CO4	Ability to design and conduct experiments as well as function in a multi disciplinary teams.
CO5	Generate analytical thought to interpret results & place them within a broader context

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	M	M	L				M		L
CO2	H	H		M	M							L
CO3	H	H	H	H	M					M		
CO4	H	H	H	H	M				H	M		L

CO5	H	M	M	M	M	L			M	M		L
H/M/L indicates strength of correlation H – High, M – Medium, L – Low												

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								
Approval									

BPH17002 MATERIAL SCIENCE 3 2 0/1 0/0

1. CRYSTAL PHYSICS (9)

Space Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Ceramic Materials & Graphite Structures – Crystal GrowthTechniques (Slow Evaporation Method & Melt Growth)

2. CONDUCTING & SUPERCONDUCTING MATERIALS (9)

Introduction - Classical Free electron theory of Metals – Derivation of Electrical conductivity – Thermal Conductivity – Deduction of Wiedemann Franz law – Fermi Energy &Fermi Function – Density of Energy States – Qualitative Analysis of Conductors, Semiconductors and Insulators – Some Examples of Important Electrical Materials

Superconducting Materials:Transition temperature – BCS Theory – Properties of Superconductors – Type I &Type II Superconductors – Superconducting materials - Low & High Temperatures Superconductors – AC& DC Josephson Effects – Applications of Superconductors – Basic Concepts of SQUID, Magnetic Levitation.

3. SEMICONDUCTING MATERIALS (9)

Bonds in Semiconductors – Types – Importance of Germanium & Silicon – Other Commonly Used Semiconducting materials - Carrier concentration in Intrinsic Semiconductors (Electron and Hole Density) – Band Gap Determination – Carrier Transport in Semiconductors – Drift, Mobility and Diffusion – Hall effect – Determination of Hall Coefficient and its Applications – Dilute Magnetic Semiconductors (DMS) & their Applications – Schottky diodes.

4.MAGNETIC& DIELECTRIC MATERIALS (9)

Magnetic Materials: Types – Comparison of Dia, Para and Ferro Magnetism – Heisenberg's interpretation –Domain theory – Hysteresis – Soft and Hard Magnetic Materials – Application of Magnetic Resonance Imaging – Important Magnetic, Insulating & Ferro electric materials.

Dielectric Materials: Electrical Susceptibility – Dielectric Constant – Concept of Polarization – Frequency and Temperature Dependence of Polarization – Dielectric loss – Dielectric breakdown – Commomly used Dielectric materials and their practical applications.

5.OPTICAL, OPTOELECTRONIC AND NEW MATERIALS (9)

Properties & Classification of Optical Materials – Absorption in Metals, Insulators & Semiconductors – Composite Materials – Nano Materials – Bio Materials – MEMS – NEMS – LED's – Organic LED's – LCD's – Laser diodes – Photodetectors – Tunneling – Resonant Tunneling Diodes (RTD's) – Carbon Nanotubes – Various Ttypes of Optical Materials with Properties.

Total No. of Periods : 45

Text Books

1. V. Rajendran&Mariakani "Materials Science", Tata McGraw Hill (2004).
2. P.K.Palanisamy," Materials science", Scitech Publication(2002).

Reference Books

1. Dr. SenthilKumar,"Engineering Physics II" VRB Publishers (2016).
2. V. Arumugam, Materials Science", Anuradha Agencies, (2003 Edition).
3. Pillai S.O., "Solid State Physics", New Age International, (2005).

DEPARTMENT OF CHEMISTRY

Subject Code : **BCH17002**	Subject Name :**ENGINEERING CHEMISTRY – II**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**2**	**0/1**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. Imparting the basic concepts of phase rule and apply the same to one and two component systems.
2. Introducing the chemistry of engineering materials such as cement, lubricants, abrasives, refractories, alloys and nano materials.
3. To impart a sound knowledge on the principles of chemistry involving different application oriented topics
4. Introducing salient features of fuels and combustion.
5. To give an overview on modern analytical techniques

COURSE OUTCOMES (Cos) : (3 – 5)Students completing the course were able to

CO1	1.	Understand the science of phase equilibria and apply the phase rule to different systems.
CO2	2.	Gain an overview of Engineering Materials such as Lime, Cement, Lubricants, Abrasives, Refractories, Alloys and Nanomaterials.
CO3	3.	Recognize the essential information about consumer products such as Soaps and Detergents, also gaining the basic knowledge about Explosives and Propellants.
CO4	4.	Discover the fuel Chemistry and Combustion process.

CO5	5. Inferring few important Analytical Techniques and their applications.											
Mapping of Course Outcomes with Program Outcomes (POs)												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L											L
CO2	M		L			L	M					L
CO3	M					L						L
CO4	M	M	L	L			M					M
CO5	M				M							H
H/M/L indicates strength of correlation H – High, M – Medium, L – Low												

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills
	√								

Approval	

DEPARTMENT OF BIOTECHNOLOGY

BCH17002 ENGINEERING CHEMISTRY – II 3 2 0/1 0/0

1. PHASE EQUILIBRIA (8)

Introduction – Definition of terms involved in phase rule. Derivation of Gibbs phase rule – Applications to one component system – water system. Binary system – Eutectic system – Pb – Ag system, Bi – Cd system .Thermal analysis – Cooling curves.

2. MATERIAL CHEMISTRY (10)

Cement – Manufacture, Chemistry of setting and hardening .Lubricants – Requirements of good lubricants, Mechanism, Properties of lubricants, Classification – Examples. Abrasives–Classification –Moh's scale-Hard and soft abrasives, Preparation of artificial abrasives (silicon carbide, boron carbide), Applications of abrasives. Refractories – Classification, Properties-Refractoriness, RUL, Porosity, Thermal spalling Alloys Classification of alloys – Purpose of making alloys - Ferrous and non-Ferrous alloys - Heat treatment Nano materials – properties, carbon nano tubes – properties, fabrication – carbon arc method, laser vapourization method.

3. APPLIED CHEMISTRY (9)

Soaps and detergents : Soaps – Saponification of oils and fats, manufacture of soaps, classification of soap – soft soap, medicated soap, herbal soap, shaving soap and creams.

Detergents – Anionic detergents – manufacture and applications, Comparison of soaps and detergents.

Rocket propellants and explosives: Rocket propellants – characteristics, solid and liquid propellants – examples. Explosives- Introduction, characteristics, classification, Oxygen balance , preparation, properties and uses of detonators, low explosives and high explosives, Dynamites, Gun cotton, Cordite.

Food adulterants- Common adulterants in different foods – milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages, Contamination with toxic chemicals – pesticides and insecticides.

4. FUELS & COMBUSTION (9)

Introduction to Fuels – classification – Calorific value – GCV, LCV. Solid Fuels–Coal-Proximate Analysis, Metallurgical Coke–Manufacture of Metallurgical Coke – Liquid Fuel–Refining of Petrol, Synthetic Petrol–Manufacturing Process–Hydrogenation of Coal, Polymerization, Cracking–Knocking–Octane Number–Leaded Petrol (or) Anti–knocking – Cetane Number–Ignition Lag–Gaseous fuels–CNG–LPG–Water Gas, Producer gas–Biogas- Combustion– Flue Gas analysis– Orsat's method.

5. ANALYTICAL AND CHARACTERIZATION TECHNIQUES

Electron microscopes: Scanning electron microscope & Transmission electron microscope, instrumentation and applications Absorption and Emission Spectrum - Beer - Lambert's law. Visible and UV Spectroscopy – instrumentation – Block diagram - working. IR Spectroscopy – instrumentation - Block diagram – molecular vibrations – stretching and bending – H_2O, CO_2. –Characterization of some important organic functional groups. Chromatographic techniques – column, thin layer and paper.

Total number of periods : 45

Textbooks

1. C. S.Unnithan, T. Jayachandran& P. Udhayakala, "Industrial Chemistry", Sreelakshmi Publications (2009).
2. Dr.R.Sivakumar and Dr.N.Sivakumar" Engineering Chemistry" Tata McGraw Hill Publishing Company Ltd, Reprint 2013.

References

1. P.C. Jain & Monika Jain, "Engineering Chemistry", DhanpatRai publishing Co., (Ltd.) (2013).

2. B. R. Puri ,L.R. Sharma &M.S.Pathania, "Principles of Physical Chemistry", Vishal publishing co., (2013).

DEPARTMENT OF ENGINEERING SCIENCES

Subject Code : **BES17003**	Subject Name : **ENVIRONMENTAL SCIENCE**	C	L	T/SLr	P/R
	Prerequisite : None	**3**	**3**	**0/0**	**0/0**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory / Lab / Embedded Theory and Lab

OBJECTIVES :

1. To acquire knowledge of the Environment and Ecosystem & Biodiversity
2. To acquire knowledge of the different types of Environmental pollution
3. To know more about Natural Resources
4. To gain understanding of social issues and the Environment
5. To attain familiarity of human population and Environment

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course were able to

CO1	To known about Environment and Ecosystem & Biodiversity
CO2	To clearly comprehend air, water, Soil, Marine, Noise, Thermal and Nuclear Pollutions and Solid Waste management and identify the importance of natural resources like forest, water, and food resources
CO3	To discover water conservation and watershed management
CO4	To identify its problems and concerns climate change, global warming, acid rain, ozone layer depletion etc.,
CO5	To explain family welfare programmes and role of information technology in human health and environment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	H	M				M
CO2						M	H			M		M
CO3						M	H	M				M
CO4						M	H	M		M		M
CO5						M	H			M		M

H/M/L indicates strength of correlation H – High, M – Medium, L – Low

Category	Basic Sciences	Engg Sciences	Humanities & Social Sciences	Program core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skills	Soft Skills

			√						
Approval									

DEPARTMENT OF BIOTECHNOLOGY

BES17003 ENVIRONMENTAL SCIENCE 3 3 0 0/0

Unit I Environment and Ecosystem (9)

Definition, Scope and Importance of environment – need for public awareness – concept, structure and function of an ecosystem - producers, consumers and decomposers – energy flow in the ecosystem. Biodiversity at national and local levels – India

Unit II Environment Pollution (9)

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Nuclear hazards (g) E-Wastes and causes, effects and control measures

Unit III Natural Resources (9)

Forest resources: Use and over-exploitation, deforestation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems.

Unit – IV Social Issues and the Environment (9)

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns climate change, global warming, acid rain, ozone layer depletion, nuclear accidents ,central and state pollution control boards- Public awareness.

Unit – V Human Population and the Environment (9)

Population growth, variation among nations – population explosion, environment and human health – human rights – value education – HIV/AIDS
– women and child welfare – role of information technology in environment and human health

Total Number of Periods : 45

Text Books

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGrawHill,NewDelhi, (2006).

References

1. Vairamani, S. and Dr. K. Sankaran. **Elements of Environmental and Health Science.**Karaikudi: KPSV Publications, 5th Edition, July, 2013.
2. Ifthikarudeen, Etal, **Environmental Studies**, Sooraj Publications,2005.

3. R.Murugesan, **Environmental Studies,** Millennium Publishers and Distributors, 2nd Edition, July, 2009.

SEMESTER - III

Subject Code:	Subject Name : BIOCHEMISTRY	TY / L / ETL	L	T / S.Lr	P/ R	C
BBT17001	Prerequisite: Chemistry	TY	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To develop understanding and provide scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

COURSE OUTCOMES (COs) : End of course students will able to

CO1	Understand the structure, organization and classification of biomolecules such as carbohydrates, proteins, lipids and nucleoproteins.
CO2	Understand the various metabolic reactions undergone by the biomolecules to understand their synthetic and degradative pathways.
CO3	Understand the process of Biological oxidation involved in the energy production by burning the food materials.
CO4	Understand the various diseases associated with the errors of metabolism of the biomolecules.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO3	M	H	H	H	H	M	H	H	L	L	L	H
CO4	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code:	Subject Name : BIOCHEMISTRY	TY / L/ ETL	L	T / S.Lr	P/ R	C
BBT17001	Prerequisite: Chemistry	Ty	3	1/0	0/0	4

UNIT I: CHEMISTRY OF BIOMOLECULES **12Hrs**

Structure, Classification and properties of Carbohydrates, Amino acids and Proteins, Lipids and Nucleo Proteins.

UNIT II: BIOLOGICAL OXIDATION **12Hrs**

Basic Concepts and Design. Electron transport chain and oxidative phosphorylation: Structure of mitochondria, the mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization, sequence of electron carriers, sites of ATP production, ATP synthetase

UNIT III: METABOLISM OF CARBOHYDRATE AND PROTEIN **12Hrs**

Glycolysis, TCA Cycle, Gluconeogenesis, Glucogenesis, glycogenolysis, Pentose phosphate shunt, Metabolic regulation, Bioenergetics. Degradation of proteins, Oxidative, Non-Oxidative deamination and decarboxylation of amino acids, Urea Cycle.

UNIT IV: LIPID AND NUCLEIC ACID METABOLISM **12 Hrs**

Uptake of lipids in animals, transport and hydrolysis of triglycerides, transport of fatty acids into mitochondria, Fatty acid oxidation: β-oxidation of saturated unsaturated fatty acids, biosynthesis of fatty acids: saturated and unsaturated fatty acids, biosynthesis and degradation of cholesterol Biosynthesis and degradation of purine and pyrimidines nucleotides,

UNIT V: BIOCHEMISTRY OF CLINICAL DISEASES **12Hrs**

Diabetes mellitus, atherosclerosis, fatty liver, and obesity, Diseases of protein metabolism, inborn errors of amino acid metabolism and Metabolic syndrome

Total Hours- 60

TEXT BOOKS

1. Nelson, L. D. and M. M Cox, (2002), *Lehninger's Principle of Biochemistry*: (3rd Ed) Macmillan, Worth Publication Inc.
2. Rama Rao A.V.S.S.,(1986) ,*Textbook of Biochemistry*.(7 th Ed) L. K. and S. Publishers.
3. Deb,A.C,(2001),*Fundamentals of Biochemistry* (7 th Ed) New central book agency Calcutta.

REFERENCE BOOKS

1. Voet & Voet,:(1995) *Biochemistry (*2nd Ed)John Wiley and Sons.
2. Jeoffrey Zubay(1993) *Biochemistry:* (3rd Ed. Vol.1, 2, 3,), Wm C. Brown Publ.

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[An ISO 21001 : 2018 Certified Institution]

DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name: ENZYME TECHNOLOGY	T/L/ ETL	L	T/ S.Lr	P/ R	C
BBT17002	Prerequisite: Nil	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To enable the students to learn enzyme reactions and its characteristics along with the production and purification process:To know the industrial applications of enzymes.

COURSE OUTCOMES (COs) : End of course students will able to

CO1	Understand enzyme and its reactions will be the key step in to proceed towards various concepts in biotechnology, the theoretical and practical aspects of kinetics will provide the importance and utility of enzyme kinetics towards research.
CO2	The process of immobilization has been increased steadily in food, pharmaceutical and chemical industries and thus this study will provide simple and easy method of implementation.
CO3	Ideas on Processing, Production and Purification of enzymes at an industrial scale will be helpful to work technologically.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO3	M	H	H	H	H	M	H	H	L	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
				✓								
Approval												

Subject Code: BBT17002	Subject Name: ENZYME TECHNOLOGY	ETL		L / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	1/0	0/0	4

UNIT I: INTRODUCTION TO ENZYMES **12Hrs**

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

UNIT II: KINETICS OF ENZYME ACTION **12Hrs**

Enzyme kinetics (steady state), determination of Km value and studying kinetics using Michalis menton, Lineweaver Burke plot parameters. Enzyme inhibition - competitive, Non competitive, Uncompetitive (Concepts with example).

UNIT III: ENZYME REGULATION **12Hrs**

General Mechanisms of enzyme regulation, Allosteric enzymes, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, cascade systems.

UNIT IV: PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES **12Hrs**

Production and purification of crude enzyme extracts from plant, animal and microbial sources – Methods of characterization of enzymes. Clinical and industrial applications of Enzymes.

UNIT V: ENZYME IMMOBILIZATION AND BIOSENSORS **12Hrs**

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

Total Hours- 60

TEXT BOOKS

1.Nicholas C. Price and Lewis Stevens, (1989), *Fundamentals of Enzymology* Oxford Univ.Press.
2.M. Dixon, E. C. Webb, CJR Thorne and K. F. Tipton(1979) *Enzymes:*, Longmans,
3.Trevor Palmer. (1999) *Understanding Enzymes*: Kindle publisher.

REFERENCE BOOKS

1.Drauz K., Gröger, H. and May O., "Enzyme Catalysis in Organic Synthesis: A Comprehensive Handbook", Volume 1, Wiley-VCH Verlag & Co, 2012.
2. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997
3. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
4. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17003	Subject Name : MICROBIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	TY	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To understand the basic structure of microorganism such as bacteria, viruses, algae fungi and phage. To have a brief knowledge about the nutrition requirements and growth curve of bacteria and also to understand the various methods to control the Microbes.

COURSE OUTCOMES (COs) : End of course students will able to

CO1	Understand the principles of Microbiology with respect to various types of microbes
CO2	Understand the basic structure and biochemical aspects of various microbes will be acquired
CO3	Solve the problems in microbial infection and their control

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO11	PO 12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO3	M	H	H	H	H	M	H	H	L	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code:	Subject Name : MICROBIOLOGY	T / L / ETL	J	T / S.Lr	P/ R	C
BBT17003	Prerequisite: Nil	TY	3	1/0	0/0	4

UNIT I: HISTORY OF MICROBIOLOGY **12Hrs**

Germ theory of disease –Spontaneous generation theory, Pasteur's contribution and Koch's contribution, Classification-systemic and numerical classification, 16Sr RNA classification. Principle of different staining techniques –Simple staining, Gram's staining, acid fast and capsule staining. Structure of prokaryotic - Cell morphology and structure capsule, endo spore formation and flagella.

UNIT II: BACTERIAL GROWTH **12Hrs**

Bacterial Growth- Growth curve, measuring the bacterial growth, factors effecting bacteria growth-physical and nutritional factors. Prevention of bacterial growth- Physical and chemical control of organisms, different mode of antibiotic action. Microbes in extreme environment – Adaptation mechanism of Halophiles, alkaliphiles, psychrophiles, Piezophile and xerophile.

UNIT III: FUNGI **12Hrs**

Classification of Fungi, Oomycetes-water mould, Chytridiomycetes- anearobic rumen fungi , Zygomycetes-Rhizopus stolonifer, Ascomycetes- Aspergillus and Basidiomycetes-smuts and rusts and lichens. Study of Yeasts – morphology and reproduction of yeasts.

UNIT IV: VIRUS **12Hrs**

Structure of virus, Classification of viruses on the basis of capsid, symmetry, enveloped .Phage - Specificity in phage infection, E.coli phage lambda.

UNIT V CONTROL OF MICROORGANISMS **12Hrs**

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.

Total Hours- 60

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg,(2005), *Microbiology* (5 thEd) TATA McGraw Hill,
2. Anantha Narayan, C.K. Jayaram Paniker, (2009), Text Book of Microbiology (7 th Ed) Orient Blackswan,
3. Prescott L.M., Harley J.P., Klein DA,(1996) Microbiology, (3rd Ed) Wm. C. Brown Publishers,

REFERENCE BOOKS

1. Jacquelyn and G.Black (2000) *Microbiology :Principles and Explorations* (7 th Ed) wiley
2. John Webster Roland Weber.(2007) *Introduction to fungi Cambridge* University Press,
3. Colin Munn.Marine (2011) Microbiology-Ecology and application (2nd Ed)Kindle publ
4. A. S. Rao Introduction to Microbiology (2006) PHI publication
   Gerard J. Tortora (2013) Microbiology: An Introduction

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17004	Subject Name :THERMODYNAMICS AND STOICHIOMETRY	T / L/ ETL	L	T / S.Lr	P/R	C
	Prerequisite: Physics / Chemistry	TY	3	0/0	0/0	3

DEPARTMENT OF BIOTECHNOLOGY

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
OBJECTIVE : To enable the students to learn about basic concepts of classical and statistical thermodynamics.												
COURSE OUTCOMES (COs) : End of course students will able to												
CO1	Understand the basic principles of classical thermodynamics to the analysis of processes and cycles involving pure simple substances.											
CO2	Impart the advanced reactor design and stability including energy balance and also to understand the basics of Biothermodynamics											
Mapping of Course Outcomes with Program Outcomes (POs)												
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	H	H	H	H	H	L	H	H
CO2	H	H	H	H	H	H	H	H	H	L	H	H
COs / PSOs	**PSO1**		**PSO2**		**PSO3**							
CO1	H		H		H							
CO2	H		H		H							
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BBT17004	Subject Name :THERMODYNAMICS AND STOICHIOMETRY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics / Chemistry	TY	3	0/0	0/0	3

UNITI: BASIC CONCEPTS OFTHERMODYNAMICS **9Hrs**

The Ideal Gas, Review of first and second laws of thermodynamics, PVT behaviour of Pure Substances, Application of the Viral Equations, Cubic Equations of State. The Vapour-Compression Cycle, the Choice of Refrigerant, Absorption, Refrigeration and liquefaction: Low temperature cycle: Linde and Claude.

UNITII:THERMODYNAMICS AND ITS APPLICATIONS **9Hrs**

The Chemical Potential and Phase Equilibria Fugacity and Fugacity Coefficient: for pure species and solution; The Nature of Equilibrium, the Phase Rule, Duhem's Theorem, Simple model's for Vapour/Liquid Equilibrium, Roult's Law, Henry's law.

UNITIII: BIOCHEMICAL THERMODYNAMICS **9Hrs**

Energetics of Metabolic Pathways; Energy Coupling (ATP & NADH); Stoichiometry and energetic analysis of Cell Growth and Product Formation - elemental Balances, Degree of reduction concepts; available-electron balances; yield coefficients; Oxygen consumption and heat evolution in aerobic cultures; thermodynamic efficiency of growth.

UNITIV:SMALL UNITS AND DIMENSIONS **9Hrs**

Basic physical Laws & concepts of vapour pressure. Buckingham Pi-theorem. Dimensionless groups, Conversion of equations, Solution of simultaneous equations, use of log-log and semi-log graph paper, triangular diagram, Graphical differentiation and graphical integration.

UNIT V: ENERGY BALANCE **9 Hrs**

General energy balance equation for steady and unsteady state processes: Without Chemical Reaction, concept of humidification and psychometric chart. With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column, Enthalpy change due to reaction: Heat of combustion, Heat of reaction for processes with biomass production.

Total Hours- 45

TEXT BOOKS

1. Smith & Vanness, *Thermodynamics for Chemical Engineers*, MGH
2. Hougen and Watson, *Chemical Process Principles* (Part one): 2nd ed, John Wiley.

REFERENCE BOOKS

1. Richardson, J.F., Peacock, D.G.Coulson & Richardson's(1998)*Chemical Engineering*- Volume (3 ed.), First Indian ed. Asian Books Pvt. Ltd.
2. David Mautner Himmelblau(1996)*Basic Principles and Calculations in Chemical Engineering* (6th Ed) Prentice Hall
3. Michael L. Shuler, Filkert Kargi(2001)*Bioprocess engineering: Basic concepts* (2nd Ed) Prentice Hall
4. Bhatt & Thakur(2012) *Stoichiometry* (1 st Ed) Tata McGraw Hill
5. C P Arora (2007) *Thermodynamics I* Tata McGraw Hill

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name :OBJECT ORIENTED PROGRAMMING FOR BIOTECHNOLOGISTS	T / L/ ETL	L	T / S.Lr	P/R	C
BCS17I04	Prerequisite: C Programming	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To enable the students to learn about basic concepts in programming for biotechnologists

COURSE OUTCOMES (COs) : End of course students will able to

CO1	Understand basic concepts of oops
CO2	The students will be able to distinguish OOPS features with procedural Oriented and analyze these features to a real world object
CO3	To develop program that support data types at runtime and handle exception

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	L	H
CO2	H	H	H	H	H	H	H	H	M	M	L	H
CO3	H	H	H	H	H	H	H	H	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BCS17I04	Subject Name :Object oriented Programming for Biotechnologists	T / L/ E/L	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **9Hrs**

Programming methodologies – Comparison – Object Oriented programming concepts-objects-classes-methods and messages-abstraction and encapsulation-inheritance-polymorphism-dynamic binding-message passing – Basics of C++ environment-tokens-keywords-identifiers and constants-data types-operators

UNIT II: CLASSES **9Hrs**

Definition – Data members – Function members – Access specifiers – Constructor – Default constructors – Copy constructors – Destructors – Static members – This pointer – Constant members – Free store operators – Control statements

UNIT III: INHERITANCE AND POLYMORPHISM **9Hrs**

Overloading operators – Function overloading – Friend function– Virtual functions – pure virtual function- Abstract classes – Inheritance-single Inheritance-multilevel Inheritance-multiple Inheritance-Hierarchical Inheritance- hybrid Inheritance.

UNIT IV: TEMPLATES **9Hrs**

Class templates – Function templates – Exception handling –try catch throw paradigm- terminate and unexpected functions – uncaught exceptions

UNIT V: STREAMS **9Hrs**

Streams and formatted I/O- I/O manipulators –file handling- random access – object serialization – namespaces – stdnamespace – ANSI string objects – standard template library

Total Hours-45

TEXT BOOKS

1. Balagurusamy.E (2008) *Object Oriented Programming with C++*, (4th ed.),TataMcGraw Hill
2. Gary J. Bronson (2005) *Object Oriented Program development using C++*,Thomson Learning
3. Object Oriented Programming in C++ : StroutStrups

REFERENCES

1. Deitel and Deitel (2011) *C++ How to Program*, (8th ed.), Prentice Hall
2. K.R.Venugopal, Rajkumar, T.Ravishankar (2010) *Mastering C++*,(36thed.),TataMcGrawHill,
3. Stanley B.Lippman (2012) *The C++ Primer* ,(5thed.),Addison Wesley.
4. OOP with C++ by M.P. Bhave & S. A. Patekar (Pearson Education)
5. OOP with C++ : Poonamchanda Sarang (PHI)

Subject Code: BBT17ET1	Subject Name : CELL BIOLOGY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	ETL	1	0/1	1/1	3

DEPARTMENT OF BIOTECHNOLOGY

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To recollect the knowledge on prokaryotic and eukaryotic cells, cell division and cell organelles. To understand transport mechanism across cell membrane. To learn the basics of cell signaling through binding of a ligand to its receptor.

COURSE OUTCOMES (COs) : Upon completion of this course, the students

CO1	Would have deeper understanding of cell at structural and functional level.
CO2	Would have broad knowledge on the molecular interaction between cells.
CO3	Would demonstrate a clear understanding of the signal transduction, secondary messengers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	L	L	M	L	H	H	L	L	L	H
CO2	M	H	L	L	M	M	H	H	L	L	L	H
CO3	M	H	L	L	M	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	H
CO2	M	H	H
CO3	M	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BBT17ET1	Subject Name :CELL BIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	ETL	1	0/1	1/1	3

UNITI: BRIEF HISTORY OF THE CELL **9Hrs**

Brief History of the cell, model organisms in research, Cells and organelles, organelles in human diseases, Cell cycle, and cell cycle regulation, apoptosis, ubiquitination, autophagy, stem cells.

UNITII: MEMBRANES **9Hrs**

Functions of membranes, models of membrane structure, membrane lipids, membrane proteins, transport across membranes – simple diffusion, facilitated diffusion through carrier proteins and channel proteins, active transport. Energetics of transport.

UNITIII:ENDOMEMBRANESYSTEMSANDPEROXISOMES **9Hrs**

Endomembrane systems and peroxisomes: Structure of E R and glogi complex. Role of E R and golgi complex in protein glycosylation, secretary pathways, protein trafficking, exocytosis, endocytosis, coated vesicles in cellular transport processes. Lysosomes and cellular digestion. Role of plant vacuole and peroxisomes.

UNITIV:SIGNALTRANSDUCTION **9Hrs**

Electrical and synaptic signaling in neurons, membrane potential, action potential; signal transduction through messengers and receptors. Chemical signals and cellular receptors; G- Protein linked receptors, protein kinase associated receptors, hormonal signaling.

UNITV: CYTO SKELETONSYSTEMS **9Hrs**

Major structural elements of the cytoskeleton, microtubules, microfilament, intermediate filament, cell-cell recognition and adhesion, cell – cell junction, extracellular matrix of animal cells, and surface of plant cells

Total Hours- 45

TEXT BOOKS

1. Jeff Hardin, Gregory Paul Bertoni, Lewis J. Kleinsmith, (2011), *Becker's World of the Cell* (8th Ed) Pearson Publ
2. Lodish, Harvey etal., *" Molecular Cell Biology*," 6th Edition. W.H.Freeman, 2008
3. Alberts, Bruce etal., *"Essentail Cell Biology*", 2nd Edition, Garland Science, 2004

REFERENCES

1. Alberts, Bruce*, "Molecular Biology of Cell*", 5th Edition, Garland Science, 2008.
2. Cooper,G.M. "*The Cell: A Molecular Approach*, 4th Edition, ASM Press, 2007
3. Thomas D. Pollard " Cell Biology" ELSEVIER 2016
4. Bruce Alberts, "Essential Cell Biology" Garland Science 2014
5. Julio E. Celis, "Cell Biology: A Laboratory Handbook" Elsevier Academic Press 2006

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17L01	Subject Name :BIOCHEMISTRY LAB	T / L/ ETL	L / T / S.Lr	P/R	C
	Prerequisite: Chemistry	0/0/60	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules

COURSE OUTCOMES (COs) : Students will acquire knowledge about

CO1	General biochemical reactions for the identification of biomolecules.
CO2	Quantitative estimation of Biomolecules
CO3	General procedures for the isolation of molecules

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	L	M	H	H	H	M	H	H
CO2	M	H	H	H	L	M	H	H	H	M	H	H
CO2	M	H	H	H	L	M	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO2	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

Subject Code: BBT17L01	Subject Name: BIOCHEMISTRY LAB	HTC / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	L	0	0/0	3/0	1

1. Laboratory Safety and Hygiene
2. Standard Operating Procedures, Units and Measurements,
3. Use of Instruments, pH and Buffers
4. Qualitative analysis of Carbohydrates(mono di and Polysaccharides)
5. Qualitative analysis of Proteins (Egg albumin , casein and Gelatin)
6. Qualitative analysis of lipids
7. Estimation of Proteins by Lowry's and Bardford Methods
8. Biological Preparations: Isolation of Caesin, and Starch

TEXT BOOKS:

1. Gupta R.C. and Bhargavan S. Practical Biochemistry.
2. David T. Phummer. Introduction of Practical Biochemistry (II Edition).
3. B.S. Rao and V.Deshpande (2005) *Experimental Biochemistry, A student companion* IK International Pvt. Ltd. (New Delhi)

REFERENCES:

1. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry, Appleton and Lange ,Stanford ,Conneticut.
2. Thomas M. Devlin. Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers

Subject Code: BBT17L02	Subject Name: MICROBIOLOGY LAB	L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

To teach the basic concept involved in the sterilization, isolation and cultivation, identification of microbes

COURSE OUTCOMES (COs) : At the end of studying the course

CO1	The students will know about good laboratory practice, this will help them to handle the microorganisms.
CO2	They will familiar with cultural and morphological characteristics of microorganisms grown in pure culture.
CO3	They will understand the practical knowledge of various biochemical phenomena by demonstrate the experiment, their applications and interpret the results.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	L	M	H	H	H	M	H	H
CO2	M	H	H	H	L	M	H	H	H	M	H	H
CO3	M	H	H	H	L	M	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

Subject Code: BBT17L02	Subject Name: MICROBIOLOGY LABORATORY	Category	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	L	0	0/0	3/0	1

1. Sterilization techniques- Autoclave, Hot air oven, Filter sterilization (lecture/demonstrations). Preparation of culture media (a) broth type of media (b) Agar
2. Culturing of Microorganisms: Pure culture techniques: Streak plate, pour plate, isolation and preservation of bacterial culture. Differential media and selective media of bacteria.
3. Enumeration of micro-organisms- Serial dilution plating
4. Identification of microorganisms. (a) Staining techniques –Simple staining, Grams staining, Capsule staining, Endospore staining,
5. Motility of bacteria by Hanging drop method.
6 .Biochemical test -Gram negative –Indole test, Methyl red test, Voges Proskauer test, Cirtate test, Triple sugar iron test
7. Biochemical test -Gram positive – Catalase test, Starch hydrolysis test.
8. Exposing the Sabouraud's agar plate in different location -Fungal identification by LPCD mount.

TEXT BOOKS

1. Monica Chessbrough(1999) *Laboratory Manual in Microbiology(Vol I & II)*Cambridge University Press
2. collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.

REFERENCE BOOKS

1. Cappucino (1999) *Microbiology - A laboratory Manual* Benjamin Cummings

Subject Code: BCS17IL4	Subject Name: OBJECT ORIENTED PROGRAMMING FOR BIOTECHNOLOGIST LAB	T/L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To enable the students to learn about basic concepts in programming for biotechnologists

COURSE OUTCOMES (COs) :

CO1	Understand basic concepts of oops
CO2	The students will be able to distinguish OOPS features with procedural Oriented and analyze these features to a real world object
CO3	To develop program that support data types at runtime and handle exception

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	L	H
CO2	H	H	H	H	H	H	H	H	M	M	L	H
CO3	H	H	H	H	H	H	H	H	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BCS17IL4	Subject Name: OBJECT ORIENTED PROGRAMMING FOR BIOTECHNOLOGIST LAB	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

1. Design C++ classes with static members, methods with default arguments,
2. Develop friend function to do matrix-vector multiplication
3. Implement complex number class with required operator overloading and type conversion.
4. Implement matrix class with dynamic memory allocation and required methods.
5. Overload the new and delete operators to provide custom dynamic allocation of memory.
6. Implement Matrix class with dynamic memory allocation and necessary methods.
7. Write a C++ program that randomly generates complex numbers
8. Develop a program that implements inheritance
9. Implement string as new data types
10. Stack with Virtual function

TEXT BOOK

1. Gary Cornell, Cay Horstmann, Core Java™ 2, Volume 2, Advanced Features, 7th Edition, Prentice Hall of India

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DEPARTMENT OF BIOTECHNOLOGY

SEMESTER - IV

Subject Code: BMA17015	Subject Name: ADVANCED MATHEMATICS FOR BIOTECHNOLOGISTS	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Mathematics	TY	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To have knowledge in the basic concepts in Algebra, Matrices, sequence and series, ordinary differential equations and functions of several variables

COURSE OUTCOMES (COs) : At the end of this course the students will able to

CO1	Understand the basic concepts of algebra & matrices
CO2	Understand the sequences &series
CO3	Understand the sequences ordinary differential equation &several variable

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	L	H	H
CO2	H	H	H	H	H	H	H	H	M	L	H	H
CO3	H	H	H	H	H	H	H	H	M	L	H	H

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	H	H									
CO2	H	H	H									
CO3	H	H	H									

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BMA17015	Subject Name :Advanced Mathematics for Biotechnologists	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Mathematics	TY	3	1/0	0/0	4

UNIT I ALGEBRA **12 Hrs**

Partial fractions – Binomial, Exponential, and Logarithmic Series (without proof of theorems) – Problems on Summation, and Approximation. (simple problems)

UNIT II MATRICES II **12 Hrs**

Determinant – Simple properties – Symmetric & Skew symmetric matrices – Unitary matrix – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Cayley - Hamilton theorem (without proof).

UNIT III SEQUENCE AND SERIES **12 Hrs**

Basic definitions of Sequence and Series – Convergence & Divergence – Ratio test – Comparison test – Cauchy's root test – Raabe's test. (simple problems)

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS **12 Hrs**

First order differential equations – Second and higher order linear differential equations with constant coefficients and with RHS of the form: e^{ax}, x^n, Sin ax, Cos ax, e^{ax} f(x), x f(x) where f(x) is Sin bx or Cos bx – Differential equations with variable coefficients (Euler's form). (simple problems)

UNIT V FUNCTIONS OF SEVERAL VARIABLES **12 Hrs**

Partial derivatives – Total differential – Differentiation of implicit functions – Taylor's expansion – Maxima and Minima by Lagrange's Method of undetermined multipliers – Jacobians.

Total no. of hrs: 60

Reference Books:

1) Kreyszig E., *Advanced Engineering Mathematics (10th ed.)*, John Wiley & Sons, (2011).
2) Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers, (2012).
3) John Bird, *Basic Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2010).
4) Vittal P.R., *Vector analysis, Analytical solid geometry, Sequences and series (3rd ed.)*, Margham Publications, (2010).
5) Veerarajan T., *Engineering Mathematics (for first year)*, Tata McGraw Hill Publishing Co., (2008).
6) P.Kandasamy, K.Thilagavathy and K. Gunavathy, *Engineering Mathematics Vol. I (4th Revised ed.)*, S.Chand & Co., Publishers, New Delhi (2000).
7) John Bird, *Higher Engineering Mathematics (5th ed.)*, Elsevier Ltd, (2006).

Subject Code: BBT17005	Subject Name : INSTRUMENTATION AND BIOPHYSICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electronics & Electrical	Ty	3	1/0	0/0	4

DEPARTMENT OF BIOTECHNOLOGY

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To impart adequate knowledge of scientific understanding of the basic concepts in instrumentation used in Biotechnology and also to impart a basic understanding about the biophysical phenomenon involved physiological systems.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Understand the skills in advanced methods of separation and analysis
CO2	Acquire practical experience in selected instrumental methods of analysis
CO3	Develop skills of students in instrumentation and biological techniques and biophysical behavior of biomolecules

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	H	H
CO2	H	H	H	H	H	H	H	H	M	M	H	H
CO3	H	H	H	H	H	H	H	H	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BBT17005	Subject Name : INSTRUMENTATION AND BIOPHYSICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Electronics & Electrical	Ty	3	1/0	0/0	4

UNIT I: SPECTROSCOPY **12Hrs**

Introduction to principles and applications of spectroscopic methods - UV-Vis, IR, Fluorescence & Phosphorescence

UNIT II: CENTRIFUGATION **12Hrs**

Centrifugation: Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation.

UNIT III: CHROMATOGRAPHY **12Hrs**

Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration, Ion Exchange, Affinity Chromatography.

UNIT IV: COLLOIDS **12Hrs**

Properties of colloids (surface tension, viscosity, surface absorption, detergent action, electrical, optical and kinetic properties). Phenomenon of osmosis and osmo regulation in the body. Electro osmosis, Donnan membrane equilibrium, its applications - artificial kidney (dialysis of blood).

UNIT V: BIOPHYSICS OF GASEOUS EXCHANGE **12Hrs**

Biophysical basis for gaseous exchange in lungs and tissues, partial pressure of CO_2 (pCO_2) and O_2(pO_2). Influence of O_2 and CO_2 in RBC and body fluids during respiration. Physiological curve of formation and dissociation of oxy hemoglobin (HbO_2) and carbon dioxide hemoglobin ($HbCO_2$). Various physiological factors in these curves.

Total Hours- 60 Hrs

TEXT BOOKS

1. Skoog DA, Thomspon Brooks and Cole(1998), *Principles of Instrumental Analysis*, (5th Ed) Harcourt Brace College Publisher
2. Willard, Merit Dean & Settle, (1986),*Instrumental methods of analysis* (6th Ed) CBS Publishers and Distributers,

REFERENCES

1. Chatwal GR (1998),*Instrumental Methods of Chemical Analysis*,(5th Ed) Himalaya Publishing House
2. Sharma BK (1994) *Instrumental Methods of Chemical Analysis*, (5th Ed)Krishna Prakashan Media Pvt Ltd 1961)
3. Edward Staunton West, Wilbert R.Todd (1961)*Textbook Of Biochemistry* (3th Ed) MacMillan Co, Publishers.
4. Roland Glaser, Biophysics (2013) Springer
5. Rodney Cotterill, Biophysics: An Introduction, Wiley publication (2002)

DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name : MICROBIAL BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17006	Prerequisite: Microbiology	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To make the students aware of the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Get familiar in the exciting area of biology of microbes
CO2	Understand the habitual and application of microbes in different products and process
CO3	Understand the sources, production and industrial application of enzymes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	M	H
CO2	H	H	H	H	H	H	H	H	M	M	M	H
CO3	H	H	H	H	H	H	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Subject Code: BBT17006	Subject Name: MICROBIAL BIOTECHNOLOGY	T / I / EVL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology	Ty	3	1/0	0/0	4

UNIT I: HISTORY AND SCOPE **12Hrs**

History and scope of microbial biotechnology, Microbial biodiversity and its use, basic functions of CBD. Berge's manual of systemic bacteriology. Mass cultivation and preservation of microorganisms. Mycotechnology, Classification in microbial biomass.

UNIT II: MICROBIAL METABOLITES **12Hrs**

Production of microbial enzymes and its applications, microbial production of antibiotics, production of single cell proteins – Commercially available forms of single cell protein for food and feed. Strain improvement. Marine microbial metabolites and biopolymer.

UNIT III: ROLE OF MICROBES **12Hrs**

Role of microorganisms for industrial, agricultural and environmental use. Beer and wine defects in industries. Bio fertilizers and Biopesticides, Large-scale production of microbial inoculants for agriculture - microbial fertilizers, microbial pesticides and Mycorhizae.

UNITIV:MICROBES IN BIOREMEDIATION AND IN GENERATION OF ENERGY **12Hrs**

Bioremediation of Xenobiotic and natural compounds - microbes in mining, ore leaching, MEOR, waste - water treatment, biodegradation of non cellulose and cellulosic wastes for environmental conservation. Lignocellulosic waste degradation. Microbes as alternative energy sources by microbial fuel cells and biofuels. Biomass from carbohydrates.

UNIT V: CASE STUDIES AND CURRENT ISSUES **12Hrs**

Production of primary metabolites, organic acids (citric acid, itaconic acid, acetic acid, gluconic acid), Amino acids (glutamic acid, lysine, aspartic acid, phenylalanine), alcohols (Ethanol, 2,3-butanediol). Case studies on Industrial contamination (Only for discussion)

Total Hours- 60 Hrs

TEXT BOOKS:

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

REFERENCES:

1. A.H. Patel " Industrial Microbiology" Macmillan
2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
6. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications

Subject Code: BBT17007	Subject Name : HEAT TRANSFER OPERATIONS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Mechanical Engineering	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To enable the students to understand the fundamental principles and concepts of heat transfer mechanisms involved in constructing bioreactors

COURSE OUTCOMES (COs) : The students will be able to understand

CO1	Importance of mixing and agitation, types of agitators, scale up of agitators and dimensional analysis.
CO2	About different modes and laws of heat transfer, and terms used for design bioreactors
CO3	Concept of forced and natural convection, boiling and condensation and radiation heat transfer on heat exchangers and its design, NTU concepts, evaporators and its types

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	M	H
CO2	H	H	H	H	H	H	H	H	M	M	M	H
CO3	H	H	H	H	H	H	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BBT17007	Subject Name : HEAT TRANSFER OPERATIONS	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Mechanical Engineering	TY	3	0/0	0/0	3

UNIT I: MIXING AND AGITATION **9Hrs**

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

UNIT II: CONDUCTION HEAT TRANSFER **9Hrs**

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

UNIT III: CONVECTION HEAT TRANSFER **9Hrs**

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

UNIT IV: RADIATION HEAT TRANSFER **9Hrs**

The problem of radiative exchange-Kirchoff's law, radiant heat exchange between two finite black holes-heat transfers among gray bodies

UNIT V: HEAT TRANSFER EQUIPMENTS **9Hrs**

Equipments; overall heat transfer coefficients; heat transfer in fermentors, design of heat exchangers; NTU concept; evaporators; single and multiple effects; mass and enthalpy

Total Hours- 45 Hrs

TEXT BOOKS:

1. McCabe, W.L., J.C. Smith and P. Harriott "Unit Operations of Chemical Engineering", 6th Edition, McGraw-Hill, 2001.
2. Geankoplis, C.J. "Transport Process and Separation Process Principles", 4th Edition, Prentice Hall of India, 2005.

REFERENCE:

1. Incropera F.P. "Fundamentals Of Heat And Mass Transfer", John Wiley,1998
2. Coulson & Richardson(1996), *Chemical Engineering, Vol-I & II*:, Butterworth Heinemann
3. Treybal, R.E.,(1988),*Mass-Transfer Operations*, (4thEd)MGH
4. Perry, Chilton & Green, (1973)*Chemical Engineers' Handbook*, MGH
5. Thomas Lestina, Process Heat Transfer: Principles, Applications and Rules of Thumb (2010)

Subject Code: BCS17I05	Subject Name : BIO DATA BASE SYSTEM	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Computer Science Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To get knowledge in database management , SQL and DB transaction

COURSE OUTCOMES (COs) : At the end of this course students will able to

CO1	Get expertise how to retrieve the data stored in the database, with help SQL
CO2	Understand how the data to be stored in electronic format by making use of Relational database
CO3	Understand the transaction reads a value from the database or writes a value to the database

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	M	H	H	H	M	M	H
CO2	L	H	H	H	H	M	H	H	H	M	M	H
CO3	L	H	H	H	H	M	H	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3				
CO1	H	H	H				
CO2	H	H	H				
CO3	H	H	H				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
Category		✓										
Approval												

Subject Code:	Subject Name : BIO DATA BASE SYSTEM	T / L/ ETL	L	T / S.Lr	P/ R	C
BCS17I05	Prerequisite: Basic Computer Science Engineering	Iy	3	0/0	0/0	3

UNIT I: PURPOSE OF DATABASE **9Hrs**

Overall System Structure - Entity Relationship Model - Mapping Constraints - Keys - E-R Diagrams - Relational Model - Structure

UNIT II: STRUCTURED QUERY LANGUAGE **9Hrs**

Basic Structure - Set Operations - Aggregate Functions - Date, Numeric, and Character Functions - Nested Sub queries -Modification Of Databases - Joined Relations-DDL - Embedded SQL.

UNIT III: RELATIONAL DATABASE DESIGN **9Hrs**

Pitfalls - Normalization Using Functional Dependencies - First Normal Form-Second Normal Form-Third Normal Form-Fourth Normal Form And BCNF.

UNIT IV: INDEXING & HASHING **9Hrs**

File and system structure – overall system structure file transaction – data dictionary – indexing and hashing basic concepts. static and dynamic hash functions
Transaction Management

UNIT V: TRANSACTIONS **9Hrs**

Transaction Concept- Properties of a Transaction- A Simple Transaction Mode- Concurrent Executions- Schedules-Serial and Non Serial types-Serialization of schedules and views-locks based protocols-time based protocols.

Total Hours: 45 Hrs

TEXT BOOK:

1. Abraham Silberschatz, H.F.Korth and S.Sudarshan-Database System Concepts McGraw Hill Publication.
2. Singh-Database systems: Concepts, Design & applications, Pearson Education.
3. G. K. Gupta, Database Management System, Tata McGraw Hill Publication (2011)

REFERENCE BOOK:

1. Gerald V.Post - DBMS-Designing and Business Applications - McGraw Hill Publications
2. Michael Abbey and Michael.J.Corey-Oracle- A Beginners guide TMH
3. Patricia Ward, Database Management Systems, Thomson learning (2006)
4. Malay K. Pakhira, Database Management Systems (2013)
5. Rajesh Narang, Database Management Systems (2011)

Subject Code: BSK17ET1	Subject Name :SOFT SKILL – I CAREER & CONFIDENCE BUILDING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	ETL	1	0/1	0/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5) The Students will be able to

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical nterviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	M	H	H	M	M	H
CO2						M	M	H	H	M	M	H
CO3						M	M	H	H	M	M	H
CO4						M	M	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1			H
CO2			H
CO3			H
CO4			H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical	Soft Skills			
									✓			

DEPARTMENT OF BIOTECHNOLOGY

Approval	

Subject Code: BSK17ET1	Subject Name : SOFT SKILL – I CAREER & CONFIDENCE BUILDING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	Ty	1	0/1	0/0	2

UNIT- I **6 Hrs**

Creation of awareness of top companies / improving skill set matrix / Development of positive frame of mind / Creation of self-awareness.

UNIT – II **6 Hrs**

Group discussions / Do's and don'ts – handling group discussions / what evaluators look for interpersonal relationships / Preparation of Curriculum Vitae / Resume.

UNIT – III **6 Hrs**

Interview – awareness of facing questions – Do's and don'ts of personal interview / group interview, enabling students to prepare for different proce3dures such as HR interviews and Technical Interviews / self-introductions.

UNIT – IV **6 Hrs**

Verbal aptitude, Reading comprehension / narration / presentation / Mock Interviews.

UNIT – V **6 Hrs**

Practical session on Group Discussion and written tests on vocabulary and reading comprehension

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 30 Hrs

Subject Code: BBT17ET2	Subject Name : GENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	ETL	1	0/1	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To impart knowledge about the basics of genetics behavioral pattern of genes. To give a outline about the various genetic disorders.

COURSE OUTCOMES (COs) : At end of completing the course the students would be able to

CO1	To understand the basics of genetic inheritance and Mendelian laws of inheritance.
CO2	To learn the organization of prokaryotic and eukaryotic chromosomes and functions.
CO3	To know the mechanism involved in chromosome segregation and different genetic disorders

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	H	H	H	L	M	M	H
CO2	M	H	H	H	H	H	H	H	L	M	M	H
CO3	M	H	H	H	H	H	H	H	L	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	H	M	H
CO3	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BBT17ET2	Subject Name : GENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : Nil	ETL	1	0/1	1/1	3

UNIT I: INTRODUCTION **9Hrs**

Nature of genetic material, Mendelian laws of inheritance, law of segregation and laws of independent assortment. Dominance and lethal genes-Dominance relationships, lethal gene action, gene interactions and Epistasis –Types of gene interaction and molecular basis of gene interaction.

UNIT II: CHROMOSOME **9Hrs**

Structural organization, variation in the number and structure of chromosome- Haploids, missing and Euploid and aneuploid, Deletion, Duplication, Translocation and structural rearrangements.

UNIT III: SEX CHROMOSOMES AND INHERITED DISEASES **9Hrs**

Vehicles of heredity, sex determination in plants and animals, Autosomal dominant disorders sex linked inheritance, non-disjunction of X chromosomes, linkage and crossing over, interference, coincidence. Molecular diseases Hemoglobinopathies, disorders of coagulation, colour blindness, hemophilia. Multiple alleles ABO blood groups, Rh group system

UNIT IV: GENE TRANSFER &MAPPING **9Hrs**

Mapping techniques-calculation of large map distances, mapping genes by mitotic segregation and recombination, mapping by in-situ hybridization. Gene transfer in bacteria-transformation, transduction, conjugation and their mapping

UNIT V: POPULATION GENETICS **9Hrs**

Principles of Hardy Weinberg law-Gene frequency, genotype frequency, Hardy Weinberg equilibrium and application, factors affecting gene frequencies. Polymorphism and characteristic features, inbreeding.

Total Hours- 45Hrs

TEXT BOOKS

1. Monroe W. Stricberger (1985) *Genetics* (3th Ed) Macmillan Publishing Company
2. Gardner (2006) *Principles of Genetics* (8th Ed) Wiley edition,
3. B.D.Singh (1999) *Fundamentals of Genetics* (3th Ed) Kalyani Publishers, New Delhi.

REFERENCE BOOKS

1. Good enough (1984*) Genetics* Saunders College Pub.
2. Singer and P.Berg (1991) *Genes and Genomes* University Science Books
3. Griffith (2000) *Genetics* W. H. Freeman
4. Hugh L. Fletcher, Genetics, Garland Science 2012
5. Anna Claybourne, Genetics, Evans Brothers 2006

Subject Code: BBT17L03	Subject Name : INSTRUMENTAL METHODS OF ANALYSIS LAB Prerequisite: Biochemistry Lab	T / L/ ETL Lb	L 0	T / S.Lr 0/0	P/ R 3/0	C 1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To understand the standard operating procedures of various instruments. To analyze the different biomolecules present in the biological system using the analytical techniques.

COURSE OUTCOMES (COs) : To train the students

CO1	To have a practical hands on experience on Absorption Spectroscopic methods
CO2	To acquire experience in the purification by performing chromatography
CO3	To validate and analysis using various methods and techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	H	H
CO2	H	H	H	H	H	H	H	H	M	M	H	H
CO3	H	H	H	H	H	H	H	H	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BBT17L03	Subject Name: INSTRUMENTAL METHODS OF ANALYSIS LAB	L/T/Lr/Lb	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab	Lb	0	0/0	3/0	1

1. Qualitative analysis: `
Normal & abnormal urine

2. Titrimetric analysis:
Estimation of titrable acidity and ammonia content of urine.

3. Colorimetric analysis:
Estimation of blood urea by Dam method.

4 .Spectrophometric analysis:
Estimation of protein by Bradford method.

5. Centrifugation technique:
Separation of serum and Plasma from blood

7. Chromatographic technique
Separation of amino acids by paper chromatography
Separation of lipids by TLC.

TEXT BOOKS:

1.Gupta R.C. and Bhargavan S. Practical Biochemistry.
2. David T. Phummer. Introduction of Practical Biochemistry (II Edition).
3.B.S. Rao and V.Deshpande (2005) *Experimental Biochemistry, A student companion* IK International Pvt. Ltd. (New Delhi)

REFERENCES:

1. Murray R.K., Granner D.K., Mayes P.A. and Rodwell V.W. Harpers Biochemistry, Appleton and Lange ,Stanford ,Conneticut.
2. Thomas M. Devlin. Textbook of Biochemistry with clinical correlations. Wiley Liss Publishers Harold Varley (1967) *Practical biochemistry* (4th Ed) Heinemann Medical,

Subject Code: BBT17L04	Subject Name :MICROBIAL BIOTECHNOLOGY LAB	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology Lab	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To understand the basic microbial systems and to know how does it help in the biodegradation and biotransformation process.

COURSE OUTCOMES (COs) : The students will have an idea

CO1	About the screening procedure of different microbes of commercial importance.
CO2	To acquire experience in the culture procedures
CO3	To validate optimization for maximum product production

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	M	M	H
CO2	H	H	H	H	H	H	H	H	H	M	M	H
CO3	H	H	H	H	H	H	H	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name: DEPARTMENT OF BIOTECHNOLOGY	L	T / S.Lr	P/ R	C
BBT17L04	LAB				
	Prerequisite: Microbiology Lab	Lb	0	0/0	3/0	1

1. Pure culture techniques
   a. Selective screening mediums for industrially important microbes
2. Isolation of fungi from soil sample and identification through slide culture technique.
3. Determination of growth curve of the given organism
4. Screening of amylase producing microorganism
5. Lyophilization of given industrially important microorganism
6. Determination of TDP (Thermal death point) and TDT (Thermal death time)

REFERENCE BOOKS

1. Cappucino (1999) *Microbiology - A laboratory Manual* Benjamin Cummings
2. T.Sundarrajan(2005) *Microbiology laboratory Manual* (4th Ed) A. Sundarraj Perungudi.

Subject Code: BCS17IL5	Subject Name: DATABASE SYSTEM LAB	L / T / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Computer Science Engineering Lab	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To get knowledge in SQL of storage, retrieval from the appropriate database

COURSE OUTCOMES (COs) : The students will have an idea

CO1	Get expertise how to retrieve the data stored in the database, with help SQL
CO2	Understand how the data to be stored in electronic format by making use of Relational database
CO3	Understand the transaction reads a value from the database or writes a value to the database

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	H	H	H	M	M	H
CO2	H	H	H	H	H	M	H	H	H	M	M	H
CO3	H	H	H	H	H	M	H	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BCS17IL5	Subject Name : BIO DATABASE SYSTEM LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Computer Science Engineering Lab	Lb	0	0/0	3/0	1

I. Program to learn SQL commands

1. Execution of DDL Commands
2. Execution of DML Commands
3. Insert Command
4. Select, From and Where Clause
5. Set Operation [Union, Intersection, Except]
6. Nested Queries
7. Join Operation
8. Modification of the Database

REFERENCE BOOKS

1. Dr. Rajiv Chopra (2014) Database Management System (DBMS), Fourth Edition, S.Chand & Company Pvt. Ltd.,
2. Bhavesh Pandya, Safa Hamdare,Asim Kumar Sen (2015),Data base Management Sytstem,Vikas Publishing House Pvt.Ltd.
3. Ramez Elmasri, Shamkant B.Navathe (2008), Fundamentals of database systems, Fifth Edition,Dorling Kindersley (India) Pvt.Ltd

Subject Code: BBT17TS1	Subject Name: BIOCHEMISTRY	L / T / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : Students are expected to understand the technical knowledge in the core domains of biotechnology such as Biochemistry, Microbiology and Chemical Engineering

COURSE OUTCOMES (COs) : The students will have an idea

CO1	About the chemistry of biological process taking place in the biological systems
CO2	About the modifications done in the living organisms for the production of beneficial products
CO3	Design of experiments and Equipments required for the production of useful products for the Society.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	M	M	M	L	M	H
CO2	M	M	M	M	M	M	M	M	M	L	M	H
CO3	M	M	M	M	M	M	M	M	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	M
CO3	M	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

Subject Code: BBT17TS1	Subject Name: [illegible]	L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

- Students will be evaluated for their Analytical skills in reagent preparation,
- Pure Culture Techniques,
- Gene expression studies
- Extraction and Purification of Biomolecules and
- Accurate estimation procedures.
- SOPs of Instruments

Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
Deemed to be University
with Graded Autonomy Status
[An ISO 21001 : 2018 Certified Institution]

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER-V

B.TECH Regulation 2017 Approved by the Academic Council 21.06.2017

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17008	Subject Name : IMMUNOLOGY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To understand the role of immune system, to gain knowledge on different lymphoid organs and types of immunity and immune responses produced. To acquire knowledge on development, maturation, activation and differentiation of T-cells and B-cells

COURSE OUTCOMES (COs) : At the end of studying this course students would be able to

CO1	Acquire basic fundamental knowledge in the immune system
CO2	Know about the different types of lymphoid organs and its functions
CO3	Understand the pathological events due to wrong immune responses

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	M	M	H	H	M	M	M	H
CO2	M	H	H	H	M	M	H	H	M	M	M	H
CO3	M	H	H	H	M	M	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	H	H									
CO2	H	H	H									
CO3	H	H	H									

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code:	Subject Name :Immunology	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17008	Prerequisite: Biochemistry & Microbiology	T	3	1/0	0/0	4

UNITI: INTRODUCTION **12Hrs**

Components of innate and acquired immunity; Organs and cells of the immune system - primary and secondary lymphoid organs; antigens: chemical and molecular nature; haptens; adjuvants; types of immune responses; theory of clonal selection.

UNIT II: CELLULAR RESPONSES **12Hrs**

Development, maturation, activation and differentiation of T-cells and B-cells; T-Cell receptors; Functional T-cell subsets; Immunoglobulins: basic structure, classes, subclasses and functions; Generation of antibody diversity; antigen-antibody reactions; antigen presenting cells: Major Histocompatibility Complex; Antigen processing and presentation: regulation of T-cell and B-cell responses; Monoclonal antibodies: Principle and Applications.

UNIT III: INFECTION AND IMMUNITY **12Hrs**

Injury and inflammation; Immune responses to infections: Immune response to infectious agents: Viruses, bacteria, fungi and parasites; Cytokines secreted by Th1 and Th2 subsets; Complement. Immune dysfunction and its consequence: Allergy and Asthma; Hypersensitivity (Type I to IV); AIDS and Immunodeficiency; Immunization; Vaccines and types: Common vaccines for humans.

UNITIV: TRANSPLANTATIONANDTUMORIMMUNOLOGY **12Hrs**

Different types of transplants; Mechanism of graft rejection; Tumor Immunology: Tumor antigens, Immune response to tumors and tumor evasion; Autoimmunity, Autoimmune disorders and diagnosis.

UNIT V: IMMUNOLOGICAL TECHNIQUES **12Hrs**

Precipitation, agglutination and complement mediated immune reactions; Blood grouping; Advanced immunological techniques - RIA, ELISA, ELISPOT assay, Immunohistochemistry, Immuno fluorescence, Flow cytometry.

Total Hours: 60

TEXT BOOKS

1. Kuby J, (2003). *Immunology,* (5th Ed), WH Freeman & Co., New York.,
2. Janeway CA, Travers P, Walport M, and Shlomchik M. (2001) *Immunobiology*, (6th Ed), Garland Science.,
3. Animated pictures & Videos : www.roitt.com

REFERENCE BOOKS

1. Roitt's (2011) *Essential of Immunology*,(12th Ed),Wiley-Blackwell.
2. Werner Luttmann “Immunology” Elsevier publication 2006
3. Thao Doan “ Immunology” Lippincott Williams & Wilkins 2013
4. David male “Immunology” Elsevier publication 2006
5. R. J. Turner “Immunology: A Comparative Approach” 2008

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17009	Subject Name :Molecular Biology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To Understand the mechanism of replication, transcription and translation. To deeply learn the molecules involved in synthesis of DNA, RNA and proteins.

COURSE OUTCOMES (COs) : By doing this course students will

CO1	Acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
CO2	Emphasize the molecular mechanism of DNA replication, repair, transcription, and protein synthesis and gene regulation in various organisms.
CO3	Articulate applications of molecular biology in the modern world

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	M	H
CO2	H	H	H	H	H	H	H	H	M	M	M	H
CO3	H	H	H	H	H	H	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BBT17009	Subject Name :Molecular Biology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	Ty	3	1/0	0/0	4

UNIT I: INTRODUCTION **12Hrs**

DNAStructure, RNAstructure, organization of the bacterial chromosome, organization of eukaryotic chromosome, chromosome duplication and segregation, Replication process of prokaryotic and eukaryotic

UNIT II: MUTATION, REPAIR AND RECOMBINATION **12Hrs**

Replication errors and their repair, proofreading, mismatch repair, Mutagens, repair of DNA damage – photo reactivation, base excision repair, homologous recombination, holliday model, recBCD pathway, role of rec A, homologous recombination in eukaryotes, site specific recombination, transposition- transposase – replicative transposition, non-replicative transposition.

UNIT III: TRANSCRIPTION AND SPLICING **12Hrs**

Types of RNA polymerases, prokaryotic and eukaryotic transcription, mechanism of splicing, spliceosome, self-splicing, alternative splicing, exon shuffling, RNAediting, mRNAtransport, inhibitors of transcription

UNIT IV: TRANSLATION AND GENETIC CODE **12Hrs**

Open reading frame, 5', 3' modifications of eukaryotic mRNAs, role of tRNAs, tRNAcharging, tRNAsynthetases, structure of ribosome, mechanism of Prokaryotic and Eukaryotic translation process, Wobble hypothesis, Deviations from the universal genetic code

UNIT V: GENE REGULATION **12Hrs**

Prokaryotes – activators and repressors, DNAlooping, cooperative binding, anti-terminations, eg. Lac operon, phage lambda regulation of lytic and lysogenic lifecycle; Eukaryotes – Homeo-domain proteins, Zn containing DNA binding domains, leucine zipper motifs, helix – loop helix proteins, nucleosome modifiers, eg. Human interferon gene, gene silencing, histone modifications, RNAi, siRNA, microRNAs

Total Hours: 60

TEXT BOOK

1. Watson et al (2004) Molecular Biology of the Gene, (5th Ed).,Pearson Education.
2. David freifelder (1987) Molecular biology Jones & Bartlett Publishers,
3. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" 4th Edition, John Wiley, 2005.

REFERENCE BOOKS

1. Baltimore (2000) Molecular biology (4th Ed): W. H. Freeman New York\
2. Lodish (2000) Molecular cell biology (4th Ed): W. H. Freeman New York
3. Lewin's GENES XI, Published by Jones & Bartlett Learning; 11 editions (2013).
4. Burton E. Tropp, Molecular biology (2012) Jones & Barlett learning
5. Michel Morange, A History of Molecular Biology, Harvard University Press (2000).

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17010	Subject Name: Recombinant DNA Technology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To gain knowledge on gene manipulation using genetic engineering methods and its importance in plant, animal and environmental biotechnology. To understand the principle behind of different enzymes and vectors used in recombinant DNA technology.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Perform the gene manipulation techniques in plant animal and Microbes
CO2	Familiar about the different enzyme systems involved in R DNA technology
CO3	Familiar about the different vectors involved in R DNA technology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	L	H
CO2	H	H	H	H	H	H	H	H	M	M	L	H
CO3	H	H	H	H	H	H	H	H	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

Subject Code: BBT17010	Subject Name: Recombinant DNA Technology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	Ty	3	0/0	0/0	3

UNIT I: ENZYMES IN RECOMBINANT TECHNOLOGY **9Hrs**

Restriction Endonucleases, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Cohesive and blunt end ligation, linkers and adaptors, homopolymer tailing, alkaline phosphatase, double digestion, TA cloning. Hybridization techniques: Southern, Northern and colony hybridization, labeling of DNA probes: Nick translation, Random priming, Radioactive and non-radioactive probes.

UNIT II: PROPERTIES OF CLONING VECTORS **9Hrs**

Plasmid Vectors : PBR 322, PUC19 vectors, Bacteriophage vectors : Insertion and replacement vectors, Cosmids, M13 Vectors, Methods for introducing DNA into cells, Transformation, Selection of recombinants, alpha complementation, replica plating. Expression vectors, Constitutive and Inducible Promoters, pMAL, GST, pET based vectors shuttle vectors, yeast vectors, artificial chromosome vectors: YAC and BAC.

UNIT III: CONSTRUCTION OF GENOMIC AND CDNA LIBRARIES **9Hrs**

Construction of Genomic and cDNA Libraries, partial digests, preparation of mRNA, cDNA, Choice of vectors, Screening of libraries - gene probes, with antibodies, characterization of plasmid clones.

UNIT IV: PRINCIPLES OF DNA SEQUENCING **9Hrs**

Principles of DNA Sequencing: Sanger's method, Maxam and Gilbert method. Automated DNA sequencing, shotgun sequencing, pyro sequencing, whole genome sequencing, PCR, Types of PCR: multiplex, RT-PCR, nested, touch-down, RACE. Applications of PCR, Gene silencing techniques: Introduction to SiRNA, SiRNA technology.

UNIT V: RECOMBINANT PROTEIN EXPRESSION **9Hrs**

Recombinant Protein Expression, Insulin, Human Growth Hormone, Hepaptitis B viral vaccine, Use of Fusion Proteins to aid in Recombinant Protein Purification, Site specific Mutagenesis Methods

Total Hours: 45

TEXT BOOK:

1. Jeremy W. Dale, Malcolm von Schantz, Nick Plant (2011) *From Genes to Genomes- Concepts and Applications of DNA Technology* (Illustrated) John Wiley & Sons
2. Keya Chaudhuri, *Recombinant DNA* technology (2013), TERI Press
3. V. L. Chopra, Genetics: Recombinant DNA technology, Oxford

REFERENCE BOOK

1. J.D. Watson, A.A. Caudy, R.M. Myers and J.A. Witkowski (2007), *Recombinant DNA*, (3rd Edition),W.H.
2. David E. Newton, DNA Technology: A Reference Handbook: A Reference Handbook, (2009)
3. Bernard R. Glick, Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press (2010)
4. Gwynneth P. Richards, Application of Recombinant DNA Technology to Commercial Mushroom Species: DNA Extractions, University of Manchester (1984)
5. Alan E. H. Emery, An Introduction to Recombinant DNA, John wiley & Sons (1984)

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17011	Subject Name :Protein Science	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

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OBJECTIVE: To recapitulate the knowledge on protein structure and its properties. To learn different methods in characterizing proteins and protein structure determination. To learn protein structure prediction and modeling and mechanism of protein folding and misfolding.

COURSE OUTCOMES (COs) : The students will be able to

CO1	Gain knowledge on protein structures and properties
CO2	Know about the Protein structure determination and their characterization
CO3	Knowledge the structure prediction and modeling and mechanism of protein folding and misfolding

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	L	H
CO2	H	H	H	H	H	H	H	H	M	M	L	H
CO3	H	H	H	H	H	H	H	H	M	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program	Open Electives	Practical /	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Subject Code: BBT17011	Subject Name: Protein Science	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	T	3	0/0	0/0	3

UNIT I: PROTEIN STRUCTURE AND CLASSIFICATION **9 Hrs**

Protein Structure and Classification: Amino acids classification, primary, secondary, tertiary and quaternary structure of proteins, protein stability and denaturation. General classes of protein structures and function. Protein folding patterns. Protein databases, Molecular Viewers to display protein structures.

UNIT II: METHODS OF CHARACTERIZING PROTEINS IN SOLUTION **9 Hrs**

Methods of Characterizing Proteins in solution, Absorbance and fluorescence of proteins, Fluoresence resonance energy transfer, circular dichroism, Protein structure determination – X-ray crystallogaphy, Nuclear magnetic resonance spectroscopy, Low temperature electron microscopy, Mass spectrometry, Protein Sequencing, Catalysis by enzymes- serine proteases; protein conformational changes, control of protein activity.

UNIT III: MOTIFS **9 Hrs**

MOTIFS, helix turn helix motifs, BETA structures, folding and flexibility , signal transduction, Membrane proteins fibrous proteins.

UNIT IV: PROTEIN ENGINEERING **9 Hrs**

Protein Engineering, folding, prediction and design-Protein folding, effect of denaturants on rate of folding and unfolding, chaperones, folding funnels, protein misfolding and GroEL – GroES chaperone protein. Protein structure prediction and modelling – CASP, homology modeling, threading, prediction of novel folds, prediction of protein function. evolution of NAD-binding domain of dehydrogenases; mechanisms of protein evolution – divergence, recruitment and mixing and matching of domains.

UNITV:PROTEIN INTERACTIONS AND PROTEINS IN DISEASE **9 Hrs**

Protein Interactions and Proteins in disease – General properties of protein-protein interfaces, protein-DNA interaction& transcription factors eg. – Lambda cro, leucine zippers, zinc fingers, membrane proteins. Diseases due to Absent or dysfunctional proteins and protein aggregation.

Total Hours : 45

TEXT BOOK:

1. Arthur M. Lesk, (2004) *Introduction to Protein Science: Architecture, Function and Genomics.* Oxford University Press

REFERENCE BOOK

1. Carl Barnden and Tooze, (1999) *Introduction to Protein Structure* , (2nd Ed) Garland publishing Inc

Subject Code: BEI17I03	Subject Name : Bioprocess Instrumentation and Control	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The introduction of need for process control and over all view of self regulation.The overview of control action and pneumatic and electronic controllers with practical form of PID.To understand the basic principles of measurements and classification of process instruments and application of sensors

COURSE OUTCOMES (COs) :At the end of this course the students would be able to know

CO1	About the process control and its regulation, electronic controllers and PID
CO2	The basic principles of measurements and their classification of the process instrumentation
CO3	About the physical and chemical sensors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	M	H
CO2	H	H	H	H	H	H	H	H	M	M	M	H
CO3	H	H	H	H	H	H	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BEI17I03	Subject Name : Bioprocess Instrumentation and Control	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	Ty	3	0/0	0/0	3

UNIT I: INTRODUCTION **9Hrs**

Need for process control – mathematical model of first – order level, pressure and thermal processes – higher order process – interacting and non-interacting systems – continuous and batch process – self-regulation – servo and regulator operation-Heat Exchanger-CSTR.

UNIT II: CONTROL ACTIONS AND CONTROLLERS **9Hrs**

Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers – Control of pH, dissolved oxygen, dissolved carbon dioxide, temperature of fermentor

UNIT III: CLOSED LOOP SYSTEMS **9Hrs**

Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, transient response of closed-loop control systems and their stability

UNIT IV: INSTRUMENTATION **9Hrs**

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow level , liquid weight and weight flow rate, viscosity, pH,
Concentration, Humidity & Moisture

UNIT V: BIOSENSORS **9Hrs**

Physical and chemical sensors; Biosensors; On-line sensors for cell properties; off-line, Analytical methods

Total Hours: 45

TEXT BOOKS

1.Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990.
2.Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.
3. Despande and R.H.Ash, Computer process control, ISA Publication, USA 1995.

REFERENCES

1. Pollard A.Process Control, Heinemann educational books, London, 1971.
2. Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991.
3. Curtis.D.Johnson, Process control Instrumentation Technolgy,PHI Learning ,2009.
4. Ahson, S.I., "Microprocessors with applications in process control", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1984.
5. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004

Subject Code: BBT17ET3	Subject Name : ANIMAL PHYSIOLOGY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology, Biochemistry	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To gain knowledge in the physiology system, properties of muscles and in pathophysiological condition of the various systems

COURSE OUTCOMES (COs) :At the end of this course the students would be able to know

CO1	The basic physiology system such as Nervous ,Endocrine, lymphatic Respiratory and Digestive
CO2	About the properties of general properties of muscles
CO3	About the pathophysiological condition involved in various system

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	L	H	L	M	M	M	M	H
CO2	H	M	M	H	L	H	L	M	M	M	M	H
CO3	H	M	M	H	L	H	L	M	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	M	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BBT17ET3	Subject Name : ANIMAL PHYSIOLOGY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology, Biochemistry	Ty	3	0/0	0/0	3

UNIT 1 : NEURAL SYSTEM **9Hrs**

Introduction to nervous system, role of nervous system, structure of nervous System, nerve impulse, synapse, neuromuscular junction – reflex action – neuro-secretory cells – neuro hormones. Introduction to endocrine system – classification of endocrine system in advanced mammals – pheromones

UNIT 2 : ENDOCRINE SYSTEM **9 Hrs**

Definition of excretion, classification of excretory projects – excretory organs, physiological process of excretion involved in mammals. Definition of circulation, functions of circulatory system, structure, composition of blood, general function of blood, transfusion, pace maker and blood pressure.

UNIT 3: LYMPHATIC, RESPIRATORY AND DIGESTIVE SYSTEM **9 Hrs**

Defintion, fields and branches of physiology, types of nutrition, digestion, absorption, assimilation in a mammal – definition, respiration, kinds of respiration, respiratory pigments – transport of respiratory gases, respiratory quotient – chloride shift and anaerobiosis

UNIT 4: **SKELETAL SYSTEM** **9 Hrs**

Introduction to muscles, types of muscles, general properties of muscles, contractile proteins, sliding filament theory – chemical changes involved during muscle contraction

UNIT 5:**PATHOPHYSIOLOGY** **9 Hrs**

Pathophysiological conditions involved in digestive, respiratory, excretory, Circulatory, muscular , nervous and endocrine systems

Total Hours: 45 Hrs

Text Books:

1. P.S.Verma, BS Tyagi, UK Agarwal – Animal Physiology, S.Chand and Co. New Delhi
2. Ross andWilson's Anatomy and Physiology in Health and Illness. 8th Edition, authors – Kathleen JWWilson and Anne Waugh. Chrchill Livingstone Publications, NewYork

Subject Code:	Subject Name : Immunology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17L05	Prerequisite: Biochemistry Lab & Microbiology Lab	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To enable the students to understand the specificities of antibodies and mechanism of antibody diversity To give laboratory training in different immunological and immunotechnological techniques.

COURSE OUTCOMES (COs) : End of the course,

CO1	The students would be aware of immune system cells and tissues
CO2	The students would have knowledge on immunological /clinical tests
CO3	The students would be able to isolate lymphocytes and monocytes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	H	H	H	H	M	H	H
CO2	M	H	H	H	H	H	H	H	H	M	H	H
CO3	M	H	H	H	H	H	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3									
CO1	H	H	H									
CO2	H	H	H									
CO3	H	H	H									

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name : Immunology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17L05	Prerequisite: Biochemistry Lab & Microbiology Lab	L	0	0/0	3/0	1

1. Identification of cells in a blood smear
2. Identification of blood group
3. Immuno diffusion SRID
4. Immunoelectrophoresis Serum, CIE
5. Testing for typhoid antigens by Widal test
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of monocytes from blood

(Experiments will be conducted using kits)

REFERENCE BOOKS

1. Kuby J, (2003). *Immunology,* (5th Ed), WH Freeman & Co., New York.,

Subject Code: BBT17L06	Subject Name : Recombinant DNA Technology Lab	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology Lab	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To apply the knowledge gained in Recombinant DNA technology and Molecular biology subjects regarding DNA, RNA and gene manipulation

COURSE OUTCOMES (COs) : Students would be able to perform

CO1	Plasmid isolation techniques
CO2	Gene expression techniques
CO2	Transformation techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	M	H	H
CO2	H	H	H	H	H	H	H	H	H	M	H	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BBT17L06	Subject Name : Recombinant DNA Technology Lab	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology Lab	L	0	0/0	3/0	1

1. Isolation of Plasmid DNA
2. Competent Cell preparation and transformation
3. Quantization of DNA by agarose gel electrophoresis and spectroscopy
4. Isolation of Plant cell and / or genomic DNA
5. Restriction Enzyme Digestion
6. Principles of Colony hybridization
7. PCR
8. Principles of RNA isolation and northern hybridization

REFERENCE BOOKS:

1. Sam brook, Frisch and Maniatis, Vol I, II and III (1989) *Molecular Cloning* (2nd Ed) Cold Spring Harbor Laboratory,

Subject Code: BEI17IL03	Subject Name : Bioprocess Process Control Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To understand the fundamentals of process control, types of processes, characteristics of different types of controllers for controlling a process

COURSE OUTCOMES (COs) : End of the semester students will able to

CO1	Understand the fundamentals involved in the process control
CO2	Learn and Operate the Control of processes using ON-OFF controllers
CO3	Learn to control the processes using PID

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	M	M	M	H
CO2	H	H	H	H	H	H	H	H	M	M	M	H
CO3	H	H	H	H	H	H	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BEI17IL03	Subject Name : BioProcess Control Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	L	0	0/0	3/0	1

1.Response of ON-OFF controller
2.Response of P+I+D controller
3.Closed loop response of Flow Control Loop
4. Closed loop response of Level Control Loop
5.Closed loop response of Temperature Control Loop

REFERENCE BOOK

1.Despande and R.H.Ash, Computer process control, ISA Publication, USA 1995

Subject Code: BBT17TS2	Subject Name: BIOTECHNOLOGY	T/L/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : Students are expected to understand the technical knowledge in the core domains of biotechnology such as Biochemistry, Microbiology and Chemical Engineering

COURSE OUTCOMES (COs) : The students will have an idea

CO1	About the chemistry of biological process taking place in the biological systems
CO2	About the modifications done in the living organisms for the production of beneficial products
CO3	Design of experiments and Equipments required for the production of useful products for the Society.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	M	M	M	L	M	H
CO2	M	M	M	M	M	M	M	M	M	L	M	H
CO3	M	M	M	M	M	M	M	M	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	M
CO3	M	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BBT17TS2	Subject Name: TECHNICAL SKILLS II	CATEGORY	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

Technical Skills-II

- Students will be evaluated for their Analytical skills in reagent preparation,
- Pure Culture Techniques,
- Gene expression studies
- Extraction and Purification of Biomolecules and
- Accurate estimation procedures.
- SOPs of Instruments

Subject Code: BBT17L07	Subject Name :INPLANT TRAINING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	0/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : Students are expected to go to any of the core industry and understand the technical knowledge in that organization.

COURSE OUTCOMES (COs) : The students will have an idea

CO1	About the working culture of the industry.
CO2	About the processes happening in the particular industry.
CO3	About the technical details and problems associated in the industry.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	M	H
CO2	M	H	M
CO3	H	M	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

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Subject Code: BBT17L07	Subject Name :INPLANT TRAINING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

Students have to undergo training in an industry or in a R&D lab for 15 full working days. Marks will be given based on the report they are submitting.

Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
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with Graded Autonomy Status
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SEMESTER - VI

Subject Code: BBT17012	Subject Name :Bioprocess Engineering	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology/Chemical Reaction Engineering/Enzyme technology	1	2	1/0	0/2	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To develop bioengineering skills by explain the different aspects of bioreactors for the production of biochemical product using integrated biochemical processes..

COURSE OUTCOMES (COs) : At the end of studying this course students would be able to

CO1	Get an overview of industrial fermentation process and process flow sheet.
CO2	Study Media requirement, formulation and optimization for fermentation.
CO3	Learn functions of a fermentor and various types of bioreactors.
CO4	Recap different types of sterilization techniques and studying sterilization kinetics.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	H	H	H	M	L	M	H
CO2	M	H	H	H	H	H	H	H	M	L	M	H
CO3	M	H	H	H	H	H	H	H	M	L	M	H
CO4	M	H	H	H	H	H	H	H	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H
CO4	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Subject Code: BBT17012	Subject Name : Bioprocess Engineering	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology, Chemical Reaction Engineering/Enzyme technology	3	2	1/0	0/2	4

UNIT I: OVERVIEW OF BIOPROCESS ENGINEERING **12Hrs**

Engineering perspective of fermentation processes – role of bioprocess engineers. Media for industrial fermentation. Medium optimization techniques. Design Of Novel Bioreactors- packed bed bioreactors, Bubble-column bioreactors, fluidized bed bioreactors, trickle bed bioreactors, airlift loop bioreactors, Batch, fed-batch and continuous reactors.

UNIT II: MICROBIAL GROWTH KINETICS **12Hrs**

Microbial growth kinetics: Growth pattern and kinetics in batch, continuous and fed batch cultures. Kinetic modeling of cell growth: prediction of specific growth rate using unstructured and un-segregated models-Monod equation, Models with growth inhibitors (substrate inhibition, product inhibition and inhibition by toxic compounds.

UNIT III: STERILIZATION KINETICS **12Hrs**

Sterilization kinetics: Medium sterilization, the design of batch and continuous sterilization process, sterilization of fermenter, feeds, liquid wastes and filter sterilization.

UNIT IV: MASS TRANSFER **12Hrs**

Gas liquid mass transfer- theories of diffusion -volumetric oxygen transfer coefficient correlations – oxygen transfer mechanism- Measurement KLa merits and demerits of each method. Scale up and scale down of bioprocess systems: operating boundaries for aerated and agitated fermentor.

UNIT V: APPLICATION OF BIOPROCESS ENGINEERING IN INDUSTRIES **12Hrs**

Food Industry-(Lactic Acid Production, baker's yeast), Pharmaceutical Industry (Penicillin Production, streptomycin), enzyme industry (amylases, protease) and production of vitamins (Vit $B_{2,}$ Vit B_{12})

Total Hours: 60

TEXT BOOKS

1. Michael L. Shuler, Filkert Kargi(2001)*Bioprocess engineering*: *Basic concepts*(2ndEd)Prentice Hall
2. Peter F. Stanbury, Stephen J. Hall & A. Whitaker (1995) ,*Principles of Fermentation Technology*, (2nd Ed) Butterworth-Heinemann.
3. A.H.Patel in Industrial microbiology.

REFERENCE BOOKS

1. Pauline. M. Doran,(1995) *Bioprocess engineering principles*, Academic press..
2. James. E.Bailey, David.F. Ollis (2002) *Biochemical engineering fundamentals*, (2nd Ed), McGraw Hill, Prentice Hall of India.
3. Mukesh Doble, Sathyanarayana and Gummadi N (2007), *Biochemical Engineering*, Prentice Hall of India Mukhopadhyay S.N (2008) *Advanced Process Biotechnology*, (1st Ed) Viva Books.
4. Bioprocess Engineering Principles By Pauline M. Doran
5. Bioprocess Engineering: Basic Concepts: Dr. Michael L. Shuler is Samuel B. Eckert Professor of Engineering at Cornell University.

Subject Code:	Subject Name :Basic Pharmaceutical Technology	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17013	Prerequisite: Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The goal is to emphasize the importance of pharmaceutical research and its usefulness in biotechnology. To impart basic concepts of drug metabolism and pharmokinetics, manufacturing principles, and biopharmaceuticals.

COURSE OUTCOMES (COs) : By doing this course students will acquire basic fundamental knowledge

CO1	About the pharmaceutical industries and process of new drug discovery.
CO2	To understand the pharmacokinetic and pharmacodynamic aspects of drugs.
CO3	To acquire basic knowledge about the preparations of various therapeutic agents and to study in detail about several biopharmaceuticals.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	M	M	M	H
CO2	M	H	H	H	H	M	H	H	M	M	M	H
CO3	M	H	H	H	H	M	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Subject Code:	Subject Name :Basic Pharmaceutical Technology	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17013	Prerequisite: Biochemistry	1	3	0/0	0/0	3

UNIT I: INTRODUCTION **9Hrs**

Introduction to Pharmaceutical Industry, Regulatory aspects, Routes of Administration of Drugs and types of therapeutic agents.

UNIT II: PHARMACOKINETICS AND PHARMACODYNAMICS **9Hrs**

Basic aspects of Pharmacokinetics. Absorption, Distribution, Biotransformation and Excretion. Factors affecting pharmacokinetics. Basic aspects of Pharmacodynamics. Mechanism of drug action Steps involved in new drug discovery. Preclinical and clinical trials**.**

UNIT III: PRINCIPLES OF DRUG MANUFACTURE **9Hrs**

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oral liquids, topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT IV: BIOPHARMACEUTICALS **9Hrs**

Various categories of therapeutics like laxatives, analgesics, contraceptives, hormones and Antibiotics

UNIT V: PHARMACEUTICAL PATENTS **9Hrs**

Introduction about the Patents related to Pharmaceutical Natural Products

Total Hours: 45

TEXT BOOKS

1. Experimental pharmaceutical technology by Eugene L Parrott
2. Pharmaceutical Technology: Table ting Technology Edited by James I. Wells
3. Encyclopedia of Pharmaceutical Technology, Second Edition, 2004 Update Supplement by James Swarbrick

REFERENCES:

1. *Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.*
2. *Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.*
3. Current Research in Pharmaceutical Technology Edited by Sabine Globig, William Hunter Jr.
4. Drugs & Pharmaceutical Technology Handbook By NIIR Board
5. Pharmaceutical Technology: Concepts and applications By S. Bharath.

Subject Code: BIT17I01	Subject Name :Bioinformatics	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Protein Science /Molecular Biology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To learn nucleotide, protein and genome databases and know about the file formats . To understand pairwise and multiple sequence alignment and the principle and to gain knowledge on approaches for gene prediction methods in prokaryotes and eukaryotes

COURSE OUTCOMES (COs) : Upon completion of this course, students will be able to

CO1	Develop bioinformatics tools with programming skills.
CO2	Apply computational based solutions for biological perspectives.
CO3	Pursue higher education in this field.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	M	M	M	H
CO2	M	H	H	H	H	M	H	H	M	M	M	H
CO3	M	H	H	H	H	M	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

Subject Code: BIT17I01	Subject Name :Bioinformatics	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Protein Science /Molecular Biology	T	3	0/0	0/0	3

UNIT I: BIOLOGICAL DATABASES AND DATA RETRIEVAL **9Hrs**

Nucleotide databases (Genbank, EMBL, DDBJ), Sequence submission Methods and tools (Sequin, Sakura, Bankit), Sequence retrieval systems (Entrez & SRS), Sequence File Formats and Conversion tools, Protein (Swiss-Prot, Tr-EMBL, PIR_PSD, Expasy), Genome (NCBI, EBI, TIGR, SANGER), Derived Databases (Prosite, PRODOM, Pfam, PRINTS), Metabolic Pathway DB (KEGG, EMP),

UNIT II: PAIRWISE SEQUENCE ALIGNMENT **9Hrs**

Similarity, Identity and Homology, Global Alignment, Local Alignment, Visual Alignment, Dynamic Programming, Heuristic approach, Database Search methods & tool, PAM & BLOSUM Matrices and Gap penalty, Assessing the Significance of Sequence Alignments

UNIT III: MULTIPLE SEQUENCE ALIGNMENT **9Hrs**

Significance of MSA, Various approaches for MSA (Progressive & Iterative), Profile analysis, Block analysis, Pattern searching, Motif analysis. Statistical methods for aiding alignment –, Gibbs Sampling, Hidden Markov Models, Algorithm of HMM-based approaches, Bali Base-Scoring of MSA, PSI/PHI-BLAST

UNIT IV: GENE PREDICTION **9Hrs**

Aryotes, Gene prediction methods, Neural Networks, Pattern Discrimination methods, Signal sites Predictions (Promoter, Splice, UTR, CpG-islands), Evaluation of Gene Prediction methods,Prediction methods using DNA sequences - Michael Zhan's Exon Finder, Gene scan

UNIT V: PHYLOGENETIC ANALYSIS & SOFTWARES IN BIOINFORMATICS **9 Hrs**

Methods of Construction of Phylogenetic trees- Maximum Parsimony Method, Maximum likelihood method and Distance Methods Emboss - Cn3D viewer- Rasmol,Swiss pdb viewer, Pymol, Jmol. Modeling, Docking -Auto dock

Total Hours: 45

TEXT BOOKS

1. A. Lesk (2002) *Introduction to Bioinformatics* (3rd Ed), Oxford University Press
2. Bioinformatics: An IntroductionBy Jeremy Ramsden
3. Bioinformatics: A Practical Approach Edited by Shui Qing Ye

REFERENCE BOOKS

1. D.E. Krane and M.L Raymer (2003)*Fundamental concepts of Bioinformatics* Pearson Education ISBN 81-297-0044-1
2. A.D. Baxevanis et. al., (2005) *Current Protocols in Bioinformatics* Wiley Publishers
3. Carlos Setubal, Joao Meidanis ,(1997) *Introduction to Computational Molecular Biology* PWS Pub.
4. Bioinformatics: Sequence and Genome Analysis by David W. Mount
5. Bioinformatics by Paul H. Dear

Subject Code:	Subject Name : Soft Skill-II	T / L / ETL	L	T / S.Lr	P/ R	C
BSK17ET2	Prerequisite: Soft skill I	ETL	1	0/1	0/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To Strengthen the vocabulary skills, reasoning, group discussion and improve their technical and HR interview

COURSE OUTCOMES (COs) : End of the course, students will able to

CO1	Reinforce their vocabulary skills
CO2	Emphasis their reasoning knowledge and group discussion, which will help them to qualify the interview
CO3	Improve the communication proficiency to global standard

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	L	L	L	L	H	H	H
CO2	L	L	L	L	L	L	L	L	L	H	H	H
CO3	L	L	L	L	L	L	L	L	L	H	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	L	L	H
CO2	L	L	H
CO3	L	L	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
									✓			
Approval												

Subject Code: BSK17ET2	Subject Name : Soft Skill-II	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Soft skill I	ETL	1	0/1	0/0	2

Dr. M.G.R.
Educational and Research Institute
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Maduravoyal, Chennai - 95
(An ISO 9001 : 2008 Certified Institution)

FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ENGLISH
QUALITATIVE AND QUANTITATIVE SKILLS
SYLLABUS – 2017 – 2018

HBMG14L02

L T P C
0 1 1 2

CURRICULUM
SOFT SKILL-II

COURSES: B.Tech

(50+50)

COURSE OBJECTIVES:
1. to strengthen the students with the needed vocabulary
2. to infer information from the given passage through reasoning
3. to train them in attending Group Discussion
4. to face the Technical and HR interview of the corporate
5. to raise communication proficiency to global standards

HBMG14L02

L T P C
0 1 1 2

Unit 1

6 hours

Preparation of resume-functional resume with objective according to different advts.-how to have interview file—how to send it by email-concept of writing email-practice through BEC method(questions and answer)

Unit 2

6 hours

Writing secretarial letters like intra-mail and inter-mail, agenda, memo and business reports-introducing GD through video-conduct of GD on a topic and also case studies

Unit 3

6 hours

Body language-grooming –Interview skill- Do's and Don'ts- mock interview –exchange of interviewer and interviewee practical session

Unit 4

6 hours

Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership.

R Pruthala

HEAD, DEPARTMENT OF ENGLISH

Unit 5

6 hours

Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series.

Total:

30 Periods

TEXT BOOKS, REFERENCE BOOKS AND WEB RESOURCES:

1. Soft Skill for Everyone-Jeff Butterfield,Part-1; Unit-D&E
2. EFA (English For All)- Dr. Padmasanni Kannan, Libin Roy Thomas
3. English for Competitive Exam- R.P. Bhatnagar,Rajul Bhargava
4. Placement Interview- S.Anandamurugan,Chapter-2&3
5. Alex K, Soft Skills ; S. Chand & Company Pvt Ltd, 2009
6. Rizvi Ashraf M, Effective Technical Communication ; Tata McGraw – Hill ; 2005
7. Thorpe, Edgar, Course in Mental Ability and Quantitative Aptitude : Tata McGraw – Hill, 2003
8. Agarwal, R.S, A Modern Approach to Verbal and Non-verbal Reasoning, S. Chand & Co ;2004
9. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017)
10. Jobsearch.about.com
11.www.exsearch.in/interview.html

COURSE LEARNING OUTCOME:

Students completing the course Soft Skill-II will

1. be strengthened in the vocabulary
2. improve their reasoning and finding a logical sequence in the passage given
3. be prepared to face Group Discussion
4. know the nuances of the interview of the corporate
5. raise communication proficiency to global standards

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17L08	Subject Name : Bioprocess Lab	T/L/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology Lab	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To gain knowledge on the up streaming process experiment. To know the selection, preparation and operation of bioreactors. To analyze how to interpret the data collected from the bioreactor**.**

COURSE OUTCOMES (COs) : At the end of this course, students will be able to

CO1	Explain about Enzyme kinetics
CO2	Characterization and how to use them for practical applications.
CO3	Evaluate the growth kinetics of microorganisms and become adapt with medium Optimization techniques.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	H	H	H	H	H	M	M	H
CO2	H	H	H	H	H	H	H	H	H	M	M	H
CO3	H	H	H	H	H	H	H	H	H	M	M	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BBT17L08	Subject Name : Bioprocess Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology Lab	L	0	0/0	3/0	1

1. Thermal death kinetics
2. Batch sterilization design
3. Residence time distribution
4. SSF
5. Bacterial cell size determination by dye adsorption technique
6. Immobilization technique
7. Amylase production

REFERENCE BOOK

1. Ponmurugan *Experimental Procedures In Bioprocess Technology & Downstream Processing* (1st Ed)
2. Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design By Shijie Liu
3. Chemical and Bioprocess Engineering: Fundamental Concepts By Ricardo Simpson, Sudhir K. Sastry

Subject Code: BBT17L09	Subject Name : Bioinformatics Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology & Protein Science	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To enable the students to understand To understand basic commands in UNIX OS. To understand different biological databases. To carry out sequence and phylogenetic analysis.

COURSE OUTCOMES (COs) : After completing this course students were able

CO1	To demonstrate the protein/DNA sequence search methods and sequence alignment databases. To understand and hands-on-training on the genome sequence analysis and annotation.
CO2	To analyze the comparative genomics.
CO3	To use various computational tools for expression analysis to identify open reading frames, mutations, conserved region

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	M	M	M	H
CO2	M	H	H	H	H	M	H	H	M	M	M	H
CO3	M	H	H	H	H	M	H	H	M	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code: BBT17L09	Subject Name : Bioinformatics Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology & Protein Science	0	0	0/0	3/0	1

1. Demonstration of Entrez and SRS
2. Exploring nucleotide database GenBank
3. Exploring Protein Database Uniprot
3. Database Searches with BLASTP and PSI BLAST
4. Protein secondary structure prediction
5. Pairwise Sequence Alignment -EMBOSS
6. Multiple sequence alignment – CLUSTAL OMEGA
7. Primer BLAST
8. Phylogenetic analysis
9. Simple Sequence Formats- Sequin(demo)

REFERENCE BOOK

1. Bioinformatics and Functional Genomics by Jonathan Pevsner
2. Bioinformatics Data Skills: Reproducible and Robust Research with Open by Vince Buffalo
3. Introduction to Bioinformatics Using Action Labs by Jean-Louis Ryan Rossi, Stephen Sheel

Subject Code: BBT17L10	Subject Name : Phytochemical Techniques Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To learn basic techniques involved in the preparation of plant compounds

COURSE OUTCOMES (COs) : End of the course, students will be able to

CO1	Process the plant material
CO2	Know the extraction process
CO3	Detect the antioxidative compounds in the plant extract

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	H	H	H	H	M	M	H
CO2	M	H	H	H	H	H	H	H	H	M	M	H
CO3	M	H	H	H	H	H	H	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	Subject Name : Phytochemical Techniques Lab	T / L / ETL	L	T / S.Lr	P/ R	C
BBT17L10	Prerequisite: Instrumentation Lab	L	0	0/0	3/0	1

1. Herbal sample preparation –drying and grinding
2. Sequential extraction using different solvent system
3. Separation techniques –TLC
4. Column chromatography
5. Quantitative analysis of alkaloids, phenols
6. Spectrophotometer analysis of flavanoids

REFERENCE BOOK:

1. Plant Drug Analysis-A TLC Atlas (by H. Wagner and S. Baldt)
2. Trease and Evans' Pharmacognosy (by W.C. Evans)
3. Pharmacognosy, Phytochemistry, Medicinal Plants (by J. Bruneton)

Subject Code: BBT17L11	Subject Name: PROJECT	T/L/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: Students have to choose a research problem in any one of the major domains and should find solutions by doing systematic research procedure.

COURSE OUTCOMES (COs) : The students will have to know

CO1	About the nature of the research problems
CO2	About the technical procedure to be followed for solving it
CO3	About the execution and presentation of the solution he has obtained.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	M	M	M	L	M	H
CO2	M	M	M	M	M	M	M	M	M	L	M	H
CO3	M	M	M	M	M	M	M	M	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	M
CO3	M	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17L11	Subject Name : Mini Project	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All Core Subjects	L	0	0/0	3/0	1

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Students have to undertake small projects in an industry, or in-house or in a R&D lab . Marks will be given based on the report they are submitting.

Subject Code: BBT17TS3	Subject Name: BIOLOGICAL SCIENCE	T/L/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : Students are expected to understand the technical knowledge in the core domains of biotechnology such as Biochemistry, Microbiology and Chemical Engineering

COURSE OUTCOMES (COs) : The students will have an idea

CO1	About the chemistry of biological process taking place in the biological systems
CO2	About the modifications done in the living organisms for the production of beneficial products
CO3	Design of experiments and Equipments required for the production of useful products for the Society.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	M	M	M	L	M	H
CO2	M	M	M	M	M	M	M	M	M	L	M	H
CO3	M	M	M	M	M	M	M	M	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	M
CO3	M	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Dr.M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
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with Graded Autonomy Status
[An ISO 21001 : 2018 Certified Institution]

DEPARTMENT OF BIOTECHNOLOGY

Technical Skills-III

- Students will be evaluated for their Analytical skills in reagent preparation,
- Pure Culture Techniques,
- Gene expression studies
- Extraction and Purification of Biomolecules and
- Accurate estimation procedures.
- SOPs of Instruments

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DEPARTMENT OF BIOTECHNOLOGY

SEMESTER -VII

DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name: Downstream Processing	T / L / ETL	L	T / S.Lr	P/ R	C
BBT17014	Prerequisite: Bioprocess Engineering	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To understand the basic fundamentals of downstream processing for biochemical product recovery.
To understand the basic principle of characterization of biomolecules and various cell disruption process.
To model biochemical product recovery, including small molecule purification

COURSE OUTCOMES (COs) : At the end of studying this course students would be able to

CO1	Acquire basic fundamental knowledge in the down streaming biochemical product recovery
CO2	Know about the different types of cell disruption process for intracellular product recovery
CO3	Understand the purification of small molecules

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	M	H	H
CO2	H	H	H	H	H	H	H	H	H	M	H	H
CO3	H	H	H	H	H	H	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name :Downstream Processing	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17014	Prerequisite: Bioprocess Engineering	T	3	1/0	0/0	4

UNIT I: INTRODUCTION **12Hrs**

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.

UNIT II: PHYSICAL METHODS OF SEPERATION **12Hrs**

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

UNIT III: ISOLATION OF PRODUCTS **12Hrs**

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

UNIT IV: FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS **12Hrs**

Crystallization, drying and lyophilization in final product formulation.

UNIT V: INDUSTRIAL HYGIENE **12Hrs**

Government regulations, Identification, Evaluation, Control. Designs to prevent fires and explosions: Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Total Hours : 60

TEXT BOOK

1. P.A. Belter, E.L. Cussler And Wei-Houhu (1988*).Bioseparations – Downstream Processing For Biotechnology*, Wiley Interscience Pun.
2. D.A. Crowl & J.F. Louvar (1990). *Chemical Process Safety (Fundamentals with applications),* Prentice Hall
3. Downstream Processing of Proteins: Methods and Protocol edited by Mohamed A. Desai(2000)

REFERENCE BOOKS

1. R.O. Jenkins, (Ed.) (1992).*Product Recovery In Bioprocess Technology – Biotechnology* Open Learning Series, Butterworth-Heinemann
2. J.C. Janson And L. Ryden, (Ed.)(1989).Protein *Purification – Principles, High Resolution Methods And Applications*, VCH Pub.
3. R.K. Scopes (1989) *Protein Purification – Principles And Practice,* (3rd Ed) Narosa Pub
4. Handbook of Downstream Processing By E. Goldberg
5. Downstream Process Technology: A New Horizon In Biotechnology (2010)By Krishna Kant Prasad, Nooralabettu Krishna Prasad

Subject Code: BBT17015	Subject Name :Animal Tissue Culture	T / L/ ETL	L	T / SLr	P/ R	C
	Prerequisite: Cell Biology	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To Understand the basic concepts of Animal tissue culture in terms of infrastructure requirement for animal cell culture . To give an idea about different types of animal tissue culture in fermentor level and its product recovery.

COURSE OUTCOMES (COs) : By doing this course students will acquire basic fundamental knowledge

CO1	About the cell culture laboratory design & equipments
CO2	About the different types of cell cultures and their applications
CO3	About the scale up process using bioreactors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H		M	H	H	M	M	H	H
CO2	M	H	H	H		M	H	H	M	M	H	H
CO3	M	H	H	H		M	H	H	M	M	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

Subject Code: BBT17015	Subject Name :Animal Tissue Culture	T / L/ P/ O	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	T	3	1/0	0/0	4

UNIT I: CELL CULTURE LABORATORY DESIGN & EQUIPMENTS **12Hrs**

Cell culture lab Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO2 incubator; Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.

UNIT II: MEDIA AND REAGENTS **12Hrs**

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

UNIT III: DIFFERENT TYPES OF CELL CULTURES **12Hrs**

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

UNIT IV: APPLICATIONS **12Hrs**

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

UNIT V: SCALE-UP **12Hrs**

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

Total Hours: 60

TEXT BOOK

1. FreshneyR I(2005) Culture of Animal Cells, (5th Ed) Wiley-Liss.
2. Plant And Animal Tissue Culture By Dr. Seema J Patel
3. Animal tissue Culture by Anil M Manae(2015)

REFERENCE BOOKS

1. John R.W. Masters (2000) Animal Cell Culture: Practical Approach (3rdEd) Oxford.
2. Clynes M, (1998) Animal Cell Culture Techniques (1st Ed) Springer.
3. Culture of Animal Cells: A Manual of Basic Technique and Specialized ...By R. Ian Freshney(2016)

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BMG17001	Subject Name : PRINCIPLES OF MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Knowledge as Management Concepts	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The student will learn

- To increasing organizational effectiveness, To achieve optimum utilization of various resources.
- To have co-ordination between various department in the organization

COURSE OUTCOMES (COs) : By doing this course students will acquire basic fundamental knowledge

CO1	Of scope , role and its function of Management Process
CO2	About the types of Organizations and authority
CO3	To co-ordinate effectively with various department

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO1 1	PO12
CO1	M	H		H		L		H		M	L	
CO2	M	H	L		M	M	L	H	L	M	L	
CO3	M		M	H		H		M		L	M	M

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	H	H
CO2	M	H	H
CO3	M	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

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Approval	

Subject Code: BMG17001	Subject Name : Principles Of Management	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Basic Knowledge as Management Concepts	T	3	0/0	0/0	3

UNIT-I **9Hrs**

Management: Importance – Definition – Nature and Scope of Management Process – Role and Functions of a Manager – Levels of Management – Development of Scientific Management and other Schools of thought and approaches.

UNIT-II **9Hrs**

Planning: Nature – Importance – Forms – Types – Steps in Planning – Objectives – Policies – Procedures and Methods – Natures and Types of Policies – Decision –making – Process of Decision – making – Types of Decision.

UNIT-III **9Hrs**

Organisation: Types of Organisations – Organisation Structure – Span of Control and Committees – Departmentalisation – Informal Organisation.

UNIT-IV **9Hrs**

Authority – Delegation – Decentralisation – Difference between Authority and Power – Responsibility – Recruitment – Sources, Selection, Training – Direction – Nature and Purpose.

UNIT-V **9Hrs**

Co-ordination – Need, Type and Techniques and requisites for excellent Co-ordination – Controlling – Meaning and Importance – Control Process.

Total Hours -45

Reference Books

1. C.B.Gupta, Management Theory & Practice -Sultan Chand & Sons - New Delhi.
2. L.M.Prasad, Principles & Practice of Management - Sultan Chand & Sons - New Delhi.
3. P.C. Tripathi & P.N Reddy, Principles of Managements - Tata Mc.Graw Hill - New Delhi.
4. Weihrich and Koontz, Management – A Global Perspective.
5. N.Premavathy, Principles of Management - Sri Vishnu Publication - Chennai.
6. J.Jayasankar, Business Management - Margham Publication - Chennai.

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Subject Code: BBT17L12	Subject Name :Downstream Processing Lab	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess Engineering	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

To provide basic training in Down stream processing for the product recovery and purification of target biological products through simple experimentations

COURSE OUTCOMES (COs) : The students will be able to

CO1	Separate the whole cells and other insoluble ingradients from the culture broth
CO2	Perform cell disruption techniques to isolate intracellular products
CO3	Carryout simple techniques like evaporation, extraction, precipitation, membrane filtration Of biological products

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

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Subject Code:	Subject Name :Downstream Processing Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT17L12	Prerequisite: Bioprocess Lab	L	0	0/0	3/0	1

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication,
3. Precipitation – ammonium sulphate precipitation
4. Ultra filtration separation
5. Aqueous two phase extraction of biological
6. High resolution purification – affinity chromatography
7. High resolution purification – ion exchange chromatography
8. Product polishing – gel filtration chromatography
9. Product polishing – spray drying, freeze drying

REFERENCE BOOKS

1. Ponmurugan *Experimental Procedures In Bioprocess Technology & Downstream Processing* (1st Ed) Anjanaa Publishing
2. Downstream Processing of Proteins: Methods and Protocols edited by Mohamed A. Desai
3. Principles of Downstream Techniques in Biological and Chemical Processes edited by Mukesh Doble
4. Downstream Process Technology: A New Horizon In Biotechnology (2012)By Krishna Kant Prasad, Nooralabettu Krishna Prasad

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Subject Code: BBT17L13	Subject Name : Animal Tissue Culture Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	L	0	0/0	3/0	1
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab						
OBJECTIVE : To be aware of tissue culture laboratory practices and maintaining sterility in lab To learn the composition and preparation of plant and animal tissue culture medium To apply the concepts learned in biochemistry and microbiology for understanding the role of medium in animal cell culture						

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Subject Code: BBT17LI3	Subject Name : Animal Tissue Culture Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisites: Cell biology	L	0	0/0	3/0	1

COURSE OUTCOMES (COs) : At the end of this course the students would be able to know

CO1	Basic requirements of animal tissue culture
CO2	Different types of Cryopreservation
CO3	Mutagenecity screening and cell viability assays

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO12
CO1	M	H	H	H	H	M	H	H	H	M	H	H
CO2	M	H	H	H	H	M	H	H	H	M	H	H
CO3	M	H	H	H	H	M	H	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PS O5			
CO1	H	H	H					
CO2	H	H	H					
CO3	H	H	H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

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1. Preparation of media, sterilization by filtration.
2. Preparation of single cell suspension from chick embryo, rat liver, human cord blood.

3. Cell counting using haemocytometer, cell viability using Trypan blue and MTT assay.
4. Fibroblast tissue culture, Mutant cell line culture, serial passage and cryopreservation.
5. Cytotoxicity and Cell proliferation kinetics.
6. Mutagenecity in cell lines& screening method: Drug induced, UV treatment,
7. Isolation of DNA from animal cell culture

REFERENCE BOOKS

1. Ian Freshney (2010) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, (6th Ed) Wiley-Blackwell.
2. Culture of Animal Cells: A Manual of Basic Technique and Specialized By R. Ian Freshney(2016)
3. Tissue Culture in Science and Society: The Public Life of a Biologic by By D. Wilson
4. Plant and Animal tissue culture by Dr. Seema J Patel

Subject Code: BBT17L14	Subject Name : PROJECT PHASE-I	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	6/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: Students have to choose a research problem in any one of the major domains and should find solutions by doing systematic research procedure.

COURSE OUTCOMES (COs) : The students will have to know

CO1	About the nature of the research problems
CO2	About the technical procedure to be followed for solving it
CO3	About the execution and presentation of the solution he/she has obtained.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	M	M	M	M	M	M	L	M	H
CO2	M	M	M	M	M	M	M	M	M	L	M	H
CO3	M	M	M	M	M	M	M	M	M	L	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	M	M	M
CO2	M	M	M
CO3	M	M	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BBT17L14	Subject Name : PROJECT PHASE-I	T / L/ ETL/C	L	T / S.Lr	P/ R	C
	Prerequisite : All core papers	L	0	0/0	6/0	2

The candidate is expected to choose a research project and collects relevant literature regarding previous work and gives an outline of the research proposal. Feasibility of the methodology, plan of experiments and future applications must also be given. The student will be graded by a committee.

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Subject Code:	Subject Name : Foreign Language	T / L/ ETL	L	T / S.Lr	P/ R	C

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BFL17001	Prerequisite: NIL	T	1	1/1	0/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To recognize the cultural values, practices, and heritage of the foreign country, communicate effectively in a foreign language and interact in a culturally appropriate manner with native speakers of that language.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Achieve functional proficiency in listening, speaking, reading, and writing.
CO2	Develop an insight into the nature of language itself, the process of language and culture acquisition.
CO3	Decode, analyze, and interpret authentic texts of different genres.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	L	L	L	L	H	L	H	M	H	H	L
CO2	M	L	L	L	L	H	L	H	H	H	H	L
CO3	L	L	M	M	L	H	M	H	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3
CO1			
CO2			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓									
Approval												

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SEMSETER VIII

B.TECH Regulation 2017 Approved by the Academic Council 21.06.2017

Subject Code: BMG17003	Subject Name : TOTAL QUALITY MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : Nil	T	3	0/0	0/0	3

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L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: Customer Perception on Quality and various dimensions of quality and International standards on Quality.

COURSE OUTCOMES (COs) : The students will have to know

CO1	To learn the basic concepts of TQM
CO2	To understand the different components in management, customer - supplier relationship and services
CO3	To learn the elements of quality systems and quality auditing

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						L		L	M	L	H	M
CO2						L		L	M	L	H	M
CO3						L		L	M	L	H	M

COs / PSOs	**PSO1**	**PSO2**	**PSO3**						
CO1	M	M	M						
CO2	M	M	M						
CO3	M	M	M						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

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Subject Code: BMG17003	Subject Name : TOTAL QUALITY MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	3	0/0	0/0	3

UNIT I **9Hrs**

Evolution of quality as a strategy- Definitions of quality, Quality Philosophies of Deming, Crossby and Miller, Service Vs product Quality, Customer focus, Quality and Business performance leadership for quality management, Quality planning, Designing for Quality and Manufacturing for Quality, Vision, Mission statements and Quality policy.

UNIT II **9Hrs**

Total Quality management- TQM models, human and system Components, Continuous Improvement Strategies, Deming wheel, Internal External Customer concept, Customer satisfaction Index, Customer retention, Team work and team building, Empowerment, TQM culture, Quality Circle, 5S principle, Top Management commitment

UNIT III **9Hrs**

Quality management tools- principles and applications of quality Function deployment, Failure Mode and Effect Modern QC techniques - Japanese Production Related Techniques: Just in time (JIT) – Quality circles – Total productive maintenance (TPM) – Kaizen – Kanban – 5 S concepts – Toyota production systems – JIDOKA –

ANDON etc. concepts. Concepts on quality management systems (QMS – ISO 9000 – 2000) – Environmental Management Systems (EMS – ISO – 14000)

UNIT V **9Hrs**

Modern Trend and Concept in Manufacturing Management: Business processes reengineering (BPR) – Lean / flexible – manufacturing systems – Six sigma concept.

TOTAL NO OF PERIODS: 45hours

REFERENCES BOOK:

1. Jill A. Swift, Joel E.Ross and Vincent K.Omachonu, *Peinciples of Total Quality*, St.Lucie Press, US, 1998.
2. Samuel K.Ho, *TQM*, An integrated approach, kogan page India Pvt Ltd, 2002
3. Dale H.N Besterfield et al, *Total Quality management*, Pearson Education Asia, 2001
4. RoseJ.E. *Total Quality Management* Kogan page India Pvt Ltd, 1993.
5. Mullar Max,' *Essentials of MAterail Management*, Amacom, 2006

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Subject Code: BBT17L15	Subject Name : PROJECT PHASE-II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Allied papers	L	0	0/0	24/24	10

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : The students will have to know

Subject Code: BBT17L15	Subject Name: PROJECT WORK PHASE I	Category	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	L	0	0/0	24/24	10

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	H	H	H	M	H	H	L	M	M	H	H
CO2	H	H	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	M

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				
Approval												

Individual or a group comprising of 2 or 3 students were expected to choose a research problem and execute it with proper data. They will explain their research project to a committee of faculty members

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ELECTIVE LIST

B.TECH Regulation 2017 Approved by the Academic Council 21.06.2017

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17E01	Subject Name: Animal Biotechnology	T/L/ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology/Molecular Biology/R DNA Technology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :.To learn the basic of animal tissue culture and the composition of different types of medium and the role of serum used in cell culture. To gain knowledge about different types of cell culture methods and applications of cell culture

COURSE OUTCOMES (COs) : After finishing this course the students would be able to

CO1	Acquire knowledge about the basics of animal cell culture
CO2	Know about the different types of medium used in animal cell culture
CO3	Understand the applications of animal biotechnology

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	M	H	H	H	H	M	H	H	H	M	L	H
CO2	M	H	H	H	H	M	H	H	H	M	L	H
CO3	M	H	H	H	H	M	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BBT17E01	**Subject Name : Animal Biotechnology**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: Cell Biology/Molecular Biology/R DNA Technology	T	3	0/0	0/0	3

UNIT I: ANIMAL TRANSGENESIS **9 Hrs**

Causes of male and female infertility; hormonal regulation of sexual differentiation; Embryo transfer technology, Techniques used in Assisted Reproductive Technology: ICSI, ZIFT, GIFT; artificial insemination, Steps involved in In-vitro fertilization (IVF) and embryo transfer; embryo sexing and embryo splitting

UNIT II: PRESERVATION AND BREEDING (ART) **9 Hrs**

Cryopreservation of embryos, enrichment of x and y bearing sperms from semen samples of animals using flowcytometer; micromanipulation technology and breeding of farm animals.

UNIT III: MICROMANIPULATION TECHNOLOGY **9 Hrs**

Concepts of transgenic animal technology; strategies for the production of transgenic animals using DNA microinjection, Production of transgenic animals using embryonic stem cells, Nuclear transfer, Applications of transgenic livestock, Production of pharmaceutical products and human proteins in transgenic live stock (biopharming), gene pharming.

UNIT IV: DIAGNOSIS OF ANIMAL DISEASES **9 Hrs**

Diagnosis of bacterial and viral diseases in animals using PCR, RFLP, Northern and Southern blotting, Fluorescent In-situ hybridization (FISH)

UNIT V: THERAPY FOR ANIMAL DISEASES **9 Hrs**

Recombinant cytokines and their use in the treatment; Types of vaccines : Recombinant subunit vaccines, Peptide vaccines, DNA vaccines and their applications in treatment of animal diseases; Principle and types of gene therapy, Advantages and disadvantages of viral vectors used in gene transfer; Non viral vector systems for gene therapy.

Total Hours : 45

TEXT BOOKS

1. Ramadass P. (2008) *Animal Biotechnology. Recent Concepts and Developments*. MJP Publishers.
2. Ranga M.M.(2002) *Animal Biotechnology*. Agrobios India Limited.
3. Sudha Gangal.(2007) *Principle and Practice of Animal Tissue Culture*, Universities Press.

REFERENCE BOOKS

1. Ian Freshney R, (2005) *Culture of Animal Cells: A manual of basic Technique*. WILEY-LISS Publication.
2. Wilson Aruni A and Ramadass P,(2011).*Animal Tissue Culture*, MJP Publishers.
3. Alan J. Holland, Animal Biotechnology and Ethics, Springer (1998)

Subject Code: BBT17E02	Subject Name : Environment Impact Assessment	T / L / ETL	L	T / S.Lr	P/ R	C

4. L.A. Babiuk, Animal Biotechnology: Comprehensive Biotechnology, First Supplement (2013)
5. R. Renaville, Biotechnology in Animal Husbandry, Springer

	Prerequisite: Solid and hazard waste management	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: To understand the Concepts and methodologies of environmental impact assessment .To study the impact of assessment procedures. To know the documentation process of environmental impact assessment.

COURSE OUTCOMES (COs) : At the end of this course the students would be able to

CO1	Know about the environmental pollution impact.
CO2	Understands the different analytical methods for pollution assessment.
CO3	Do the documentation process on impact assessment.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
CO1	M	H	H	H	H	H	H	H	M	M	H	H
CO2	M	H	H	H	H	H	H	H	M	M	H	H
CO3	M	H	H	H	H	H	H	H	M	M	H	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E02	Subject Name : Environment Impact Assessment	T / L / ETL	U	T / S.Lr	P/ R	C
	Prerequisite: Solid and hazard waste management	T	3	0/0	0/0	3

UNIT I: EVOLUTION OF EIA **9 Hrs**

Evolution of EIA – Concepts – Methodologies – Screening – Scoping – Base line studies - Mitigation – Matrices – Check list.

UNIT II: RAPID AND COMPREHENSIVE EIA **9 Hrs**

Rapid and Comprehensive EIA – Legislative and Environmental clearance procedures in India – Prediction tools for EIA.

UNIT III: ASSESSMENT OF IMPACTS **9 Hrs**

Assessment of impacts – Air – Water – Soil – Noise – Biological. Socio cultural environment – Public participation – resettlement and rehabilitation.

UNIT IV: DOCUMENTATION OF EIA **9 Hrs**

Documentation of EIA – Environmental Management plan – Post project monitoring – Environmental Audit – Life cycle assessment – EMS

UNIT V: CASE STUDIES **9 Hrs**

Case studies in EIA

Total Hours : 45

TEXT BOOKS

1. Canter R.L.(1997) *Environmental Impact Assessment*, Mc Graw Hill International Edition,
2. Richard K.Morgan. Environmental Impact Assessment : A Methodological Approach
3. John Glasson, Introduction to Environmental Impact Assessment (2013)

REFERENCE BOOKS

1. John G. Rau and David C. Wooten (Ed)(1980), *Environmental Impact Analysis Handbook*, (1st Ed)McGraw Hill Book Company.
2. Richard K. Morgan, Environmental Impact Assessment: A Methodological Approach (1999)
3. Peter Wathern, Environmental Impact Assessment: Theory and Practice (2013)
4. John Glasson, Introduction to Environmental Impact Assessment (2013)
5. David P. Lawrence, Environmental Impact Assessment (2003)

Subject Code: BBT17E03	Subject Name : Stem cells and Developmental Biology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To study the principles of developmental biology in the early embryonic development. To study the stem cell processing and its therapeutic applications.

COURSE OUTCOMES (COs) :At the end of this course the students gain knowledge about to

CO1	Developmental biology in terms of embryonic cells.
CO2	The concept and basic knowledge about stem cells.
CO3	Understand the applications of stem cells.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	H	H	H	H	M	L	H
CO2	M	H	H	H	H	H	H	H	H	M	L	H
CO3	M	H	H	H	H	H	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BBT17E03	Subject Name : Stem cells and Developmental Biology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	T	3	0/0	0/0	3

UNIT I: PRINCIPLES OF DEVELOPMENTAL BIOLOGY **9 Hrs**

Developmental biology: The anatomical tradition/Life cycles and the evolution of developmental patterns; principles of experimental embryology; The genetic core of development; The paradigm of differential gene expression, cell commitment, differentiation & induction of cell fate; concept of morphogen, cell-cell communication in development.

UNIT II: EARLY EMBRYONIC DEVELOPMENT **9 Hrs**

Fertilization: Beginning a new organism. Early development in selected invertebrates; the genetics of axis specification in Drosophila; Early development and axis formation in amphibians; the early development of vertebrates: fish, birds and mammals.

UNIT III: INTRODUCTION TO STEM CELLS **9 Hrs**

Development of differentiated tissues from embryonic germ layers, Function of placenta, amniotic fluid and umbilical cord; Stem cells : Definition, Classification and Properties; Properties and application of Embryonic stem cells; Hematopoiesis – Hierarchy, Properties of Hematopoietic Stem Cells (HSCs) and types.

UNIT IV: STEM CELL PROCESSING AND TRANSPLANTATION **9 Hrs**

Sources of stem cells; Cell types for transplantation: Bone marrow, Peripheral stem cells, cord blood stem cells; Types of transplants; Methods of obtaining bone marrow and peripheral blood for transplant, Stem cell processing and storage; HLA matching; Advantages and drawbacks of autologous and allogeneic transplants.

UNIT V: STEM CELLS AND THERAPY **9 Hrs**

Overview of embryonic and adult stem cells for therapy; Normal stem cells vs Cancer stem cells, Clinical uses of hematopoietic stem cells in leukemia and inherited blood disorders; Use of stem cells in diabetes, myocardial infarction, Parkinson's disease.

Total no of Hours: 45

TEXT BOOK

1. Scott F Gilbert (2000) ,*A companion to Developmental Biology*,(9th Ed), Sunderland (MA): Sinauer Associates;
2. Robert Lonza (2009) *Essentials of Stem Cell Biology*, (2nd Ed) Academic Press.
3. Krishnarao Appasani, Stem Cells & Regenerative Medicine (2010)

REFERENCE BOOK

1. Anthony Atala, Robert Lonza, James A.Thomson, Robert Nerem (2011) *Principles of Regenerative Medicine*, (2nd Ed) , Academic Press.
2. StemBook Cambridge (MA): 2008.Harvard Stem Cell Institute;
3. Lewis Wolpert, Developmental Biology: A Very Short Introduction (2011)
4. Robert Lanza, Essentials of Stem Cell Biology (2013)
5. Hossein Baharvand, Trends in Stem Cell Biology and Technology (2009)

Subject Code: BBT17E04	Subject Name: Genomics	T/L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology/Recombinant DNA Technology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To study the Structure and organization of prokaryotic and eukaryotic genome .To give a background idea about Human genome project .To introduce pharmacogenetics and epigenetics.

COURSE OUTCOMES (COs) : At the end of this course the students gain knowledge about

CO1	Structure and organization of eukaryotic genome
CO2	The concept and basic knowledge about human genome project
CO3	Understand the Pharmacogenetics and Epigenetics concepts.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	L	H	H	H	M	L	H
CO2	L	H	H	H	H	L	H	H	H	M	L	H
CO3	L	H	H	H	H	L	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BBT17E04	Subject Name: Genomics	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology/Recombinant DNA Technology	T	3	0/0	0/0	3

UNIT I: INTRODUCTION TO GENOMICS **9 Hrs**

Introduction – Structure and organization of prokaryotic and eukaryotic genome; Genome size and C value paradox; Repetitive DNA sequences in genome, Tools for genome analysis-RFLP, DNA fingerprinting, RAPD-PCR. Analysis of sequence data : Gene identification, Open Reading Frame (ORF), Exon-intron boundary, Gene prediction methods in prokaryotes and eukaryotes.

UNIT II: GENOME ANALYSIS **9 Hrs**

Background of Human genome project, Physical mapping, Markers for physical mapping: Cytogenetic map, STS map, EST map, Radiation hybrid map; Genetic mapping and Linkage analysis; Whole genome sequencing methods – Clone by clone method and shotgun sequencing; Chromosome walking and chromosome jumping; Metagenomics, 16S rRNA typing.

UNIT III: ANALYSIS OF GENE EXPRESSION **9 Hrs**

Introduction to gene expression, Methods for gene expression analysis: RNAse protection assay, Real-time RT-PCR, SAGE; Comparing transcriptome: Differential Display, Subtractive hybridization; Microarrays – principle, types and methodology of cDNA arrays and Oligonucleotide arrays; Applications of microarrays; Analysis of microarray data.

UNIT IV: PHARMACOGENETICS **9 Hrs**

Single nucleotide polymorphisms (SNPs) and types, Techniques for detection of SNPs : RFLP, Allele specific PCR, Allelic discrimination assay; CYP enzymes involved in drug metabolism; Polymorphism in drug metabolizing enzymes and its effects; Process of drug discovery; Phases of clinical trials; High throughput screening for drug discovery.

UNIT V: EPIGENETICS **9 Hrs**

DNA methylation, DNA methyl transferases, CpG island methylation, Mechanism of transcriptional repression by methylation, Methods for detection of DNA methylation: Restriction analysis, Bisulfite PCR;

Total Hours : 45

TEXT BOOKS

1. Campbell AM & Heyer LJ, (2007) *Discovering Genomics, Proteomics and Bioinformatics*,(2nd Ed), Benjamin Cummings.
2. Arthur Lesk, Introduction to Genomics, Oxford University press (2012)
3. J. Mark Cock, Introduction to Marine Genomics, Springer (2010)

REFERENCE BOOKS

1. Brown TA, (2006) *Genomes*,(3rdEd), Garland Science.
2. Sahai S, (1999).*Genomics and Proteomics, Functional and Computational Aspects*, Plenum Publication.
3. Gerald Ankley, Genomics in Regulatory Ecotoxicology: Applications and Challenges (2007)
4. Tom Strachan, Genetics and Genomics in Medicine (2014)
5. Dhavendra Kumar, Genomics and Health in the Developing World (2012)

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17E05	Subject Name : Biofuel	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To give an introduction to biogas technology .To understand the basics behind the bioethanol and biodiesel production. To give basic idea for the production of green energy from biomass

COURSE OUTCOMES (COs) : At the end of this course the students gain knowledge about

CO1	Biogas produced by different components.
CO2	The concept and basic knowledge about bioethanol and biodiesel production.
CO3	Understand the production of green energy.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	H	H	H	M	L	H
CO2	H	H	H	H	H	M	H	H	H	M	L	H
CO3	H	H	H	H	H	M	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E05	Subject Name : Biofuel	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	T	3	0/0	0/0	3

UNIT I: BIOGAS TECHNOLOGY-I **9 Hrs**

Biogas Technology -I Worldwide perspective of anaerobic digestion, Review of anaerobic digesters, Microbiology of biogas production, Methods to enhance the biogas production, Design parameters affecting the success and failure of biogas plants, Structural behavior and stress conditions in fixed dome biogas plant, Performance of different types of gas holders.

UNIT II: BIOGAS TECHNOLOGY-II **9 Hrs**

Biogas Technology-II Alternate constructions material for biogas plant construction, Various techniques for increasing gas production in cold region. Effect of heating , insulation and stirring on gas production, Design optimization for biogas production, Alternate feedstock for biogas production. Effect of pesticides on anaerobic digestion, Effect of herbicide on anaerobic digestion,

UNIT III: BIO-ETHANOL AND BIO-DIESEL TECHNOLOGY **9 Hrs**

Bio-Ethanol and Bio-Diesel Technology**:** Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel.

UNIT IV: GREEN TECHNOLOGY – MICROBIAL FUEL CELL: **9 Hrs**

Green Technology – Microbial Fuel Cell**:** Types of Biological fuel cells – Working Principle - Applications of biological Fuel cells.

UNITV: ENERGY FROM BIOMASS **9 Hrs**

Energy from Biomass – Introduction – Biomass conversion Technologies – Photosynthesis – Biogas generation – Factors affecting Biodigestion – Pyrolysis – Alcohol fuels - Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems: Combustion of Woody Biomass

Total Hours: 45

TEXT BOOKS

1. G.D.Rai (2011), *Non-Conventional Energy Sources* , Khanna Publishers.
2. B.H.Khan,(2006*) Non-conventional Energy Sources* , The McGraw Hill Companies.
3. Ahindra Nag, Biofuels Refining and Performance, The McGraw Hill Companies (2008)

REFERENCE BOOKS

1. Halwagi,(1984) *Biogas Technology - Transfer and Diffusion.* MNES Publication.
2. Chawla, O.P, (1986)*Advances in Biogas technology.* Publications and Information Division, Indian Council of Agricultural Research.
3. David M. Mousdale, Biofuels: Biotechnology, Chemistry, and Sustainable Development (2008)
4. Paula Johanson, Biofuels: Sustainable Energy in the 21st Century (2010)
5. Geoffrey M. Horn, Biofuels, Chelsea house publishers (2010)

Subject Code:	Subject Name : Solid and hazardous waste water management	T / L/ ETL	L	T / SLr	P/ R	C
BBT17E06	Prerequisite: Microbiology/Chemical Reaction Engineering	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To study the types and source of solid and hazardous waste and its generation rates. To study the handling and segregation and processing of wastes

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the basic knowledge about source of contamination of environment.
CO2	Know about the segregation process and processing.
CO3	Management of disposal of landfills.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO10	PO1 1	PO12
CO1	H	H	H	H	H	H	H	H	H	M	L	H
CO2	H	H	H	H	H	H	H	H	H	M	L	H
CO3	H	H	H	H	H	H	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E06	Subject Name : Solid and hazardous waste water management	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	T	3	0/0	0/0	3

UNIT I: TYPES AND SOURCES **9 Hrs**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management - Legislations on management and handling of municipal solid wastes, hazardous wastes, and biomedical wastes.

UNIT II: WASTE GENERATION **9 Hrs**

Waste generation rates – Composition - Hazardous Characteristics – TCLP tests – waste sampling- Source reduction of wastes – Recycling and reuse.

UNIT III: HANDLING AND SEGREGATION **9 Hrs**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labeling and handling of hazardous wastes.

UNIT IV: WASTE PROCESSING **9 Hrs**

Waste processing – processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNITV: DISPOSAL IN LANDFILLS **9 Hrs**

Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – landfill remediation. Elements of integrated waste management.

Total Hours: 45

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, (1993) *Integrated Solid Waste Management*, McGraw- Hill, New York.
2. M.N. Rao, Solid and Hazardous Waste Management: Science and Engineering, Elsevier (2016)
3. P. M. Cherry, Solid and Hazardous Waste Management, CBS Publishers & Distributors, (2016)

REFERENCE BOOK

1. CPHEEO, (2000) *Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization*, Government of India, New Delhi.
2. Edward J. Martin, Hazardous Waste Management Engineering, Kluver publications (1987)
3. Cliff Vanguilder, Hazardous Waste Management: An Introduction, Mercury Learning and Information, (2012)
4. Gaynor W. Dawson, Hazardous Waste Management, John Wiley & Sons (1986)
5. George Tchobanoglous, Handbook of Solid Waste Management, McGraw Hill Professional, 2002

Subject Code: BBT17E07	Subject Name : Phytochemical Technology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Pharmaceutical	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To explain the concept of phytochemical technology and various methods of its extraction. The objective also includes the analysis of plant drugs and standardization of herbal drugs.

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Get an idea about Medicinal Plants
CO2	Know about the different extraction procedures
CO3	Understand the standardization procedures for the commercial use of herbal drugs

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	L	M	H	H	M	L	H
CO2	L	H	H	H	H	L	M	H	H	M	L	H
CO3	L	H	H	H	H	L	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E07	Subject Name: Phytochemical Technology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Pharmaceutical	T	3	0/0	0/0	3

UNIT I: INTRODUCTION TO MEDICINAL PLANTS **9 Hrs**

Introduction to Medicinal Plants, Classification of secondary metabolites, Medicinal importance of secondary metabolites like Flavonoids, Phenols, Alkaloids, Tannins Terpenes and Saponins.

UNIT II: EXTRACTION **9 Hrs**

Extraction of Phyto pharmaceuticals – Infusion, Decoction, Digestion, Maceration, Percolation, Successive Solvent Extraction, Super Critical Fluid Extraction

UNIT III: EXTRACTION **9 Hrs**

Steam Distillation, Headspace Techniques, Sepbox, Selection of Suitable Extraction Process, Carbohydrates, Proteins, Alkaloids, Glycosides.

UNIT IV: PLANT DRUG ANALYSIS **9 Hrs**

Application of Chromotography and Spectroscopy in Plant Drug Analysis – Infrared Spectroscopy, NMR Spectroscopy, Mass Spectroscopy.

UNIT V: STANDARDIZATION OF HERBAL DRUGS **9 Hrs**

Standardization of Herbal Drugs – Importance of Standardization and Problems Involved in the Standardization of Herbs, Standardization of Single Drugs and Compound Formulations, WHO Guidelines for Quality Standardized Herbal Formulation, Estimation of Parameter Limits used for Standardization, Herbal Extracts.

Total Hours : 45

TEXT BOOK

1. S.S. Agarwal, M.Paridhavi (2007) *Herbal Drug Technology* (1st Ed), University press (India) private limited
2. N. Raaman, Phytochemical Techniques, New India Publishing Agency (2006)
3. Colleen Carkeet, Phytochemicals: Health Promotion and Therapeutic Potential, (2012)

REFERENCE BOOK

1. A.P.Purohit, C.K.Kokate , S.B.Gokhale (2001) *Pharmacognosy* (32nd Edition) Nirali Prakshan pune.
2. Trease GE , Evans WC *Pharmacognosy* (14th Edition) W.B.Sondars & Co Ltd London.
3. Kelsey R. Downum, Phytochemical Potential of Tropical Plants, Springer (2013)
4. Amlan K. Patra, Dietary Phytochemicals and Microbes, Springer (2012)
5. David R Gang, Phytochemicals, Plant Growth, and the Environment, Springer (2012)

Subject Code: BBT17E08	Subject Name :Food Biotechnology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To learn role of food additives in food processing and preservation. To know the role of bacteria, yeast and mould in food processing and role of fermentation of food ,.
To be aware of food borne diseases caused and food poisoning.

COURSE OUTCOMES (COs) : At the end of studying this course the student to

CO1	Get an idea about the microbes in the food
CO2	Know about the different starter cultures as well as nutritional enhancers
CO3	Understand the preservation during storage of the commercial foods

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	M	M	H	H	M	L	H
CO2	L	H	H	H	H	M	M	H	H	M	L	H
CO3	L	H	H	H	H	M	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E08	Subject Name : Food Biotechnology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology	T	3	0/0	0/0	3

UNIT I: HISTORICAL BACKGROUND **9 Hrs**

Historical background: History of microorganism in food, Historical developments, Taxonomy: role and significance of microorganism in foods, Intrinsic and extrinsic parameters of foods that affect microbial growth, Microorganisms in fresh meats and poultry, Processed meats, seafoods, Fermented and fermented dairy products and miscellaneous food products.

UNIT II: STARTER CULTURES **9 Hrs**

Starter cultures: Cheeses,beer, wine and distilled spirits, SCP, Medical foods, Probiotics and Health benefits of fermented milk and food products;Brewing ,malting ,mashing,hops, primary and secondary fermentation:Biotechnological improvements,catabolic repression,High gravity brewing , B – glucan problem,Getting rid of diacetyl,Beer , wine and distilled spirits.

UNIT III: NUTRITIONAL BOOSTS AND FLAVOUR ENHANCERS **9 Hrs**

Nutritional boosts and flavour enhancers: Emerging processing and preservation technologies milk and dairy products. Microbiological examination of surfaces, Air sampling, Metabolically injured organisms, Enumeration and detection of food – borne organisms. Bioassay and releated methods.

UNIT IV: FOOD PRESERVATION **9 Hrs**

Food preservation: Food preservation using irradiation, Characteristics of radiations of interest in Food preservation, Principle underlying the destruction of microorganisms by irradiation, Processing of foods for irradiation, Application of Radiation, Radappertization, Radicidation, and Radurization of foods legal status of food irradiation, Effect of irradiation of food constituents.

UNIT V: STORAGE **9 Hrs**

Storage stability food preservation with low temperatures, Food preservation with high temperatures, Preservation of food by drying, Indicator and food- borne pathogens, Other proven and food- borne pathogens. Food standards and Specifications: Compulsory and voluntary trade and Company standards. Consumer Protection Act (1986), AgMark, BIS, US, Canadian, EU, ISO and Codex Food Standards, Export Quality Control and Inspection act (1963),

Total Hours: 45

TEXT BOOKS

1. Michael J. Pelezar, J.R.E.C.S Chan, Noel R. Erieg,(2005), *Microbiology* (5thEd) TATA McGraw Hill.
2. Anthony Pometto, Food Biotechnology, Second Edition, Taylor and Fancis (2005)
3. Y. H. Hui, Food Biotechnology: Microorganisms, (1995)

REFERENCE BOOKS

1. James M. Jay (1993). *Modern Food Microbiology* (4th Ed). CBS Publishers Delhi.
2. W. C. Frazier & D.C. Westhoffs, (1993). "*Food Microbiology*" (4th Ed) TMH
3. Julie Eckinger, Food Biotechnology in Ethical Perspective (2007)
4. S.C. Bhatia, Food Biotechnology (2016)
5. Sarah Elderidge, Food Biotechnology: Current Issues and Perspectives (2003)

Subject Code: BBT17E09	Subject Name: Clinical Biochemistry	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To study the basic concept of clinical biochemistry and to gain knowledge about the inborn error of metabolism.To have knowledge on the clinical enzymology study

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the disease related and inborn error in the metabolism
CO2	Understand the different organ test like liver test and gastric function test etc
CO3	Understand the Enzyme patterns in various function

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO 3	PO 4	PO 5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						

Approval	

Subject Code: BBT17E09	Subject Name Clinical Biochemistry	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	3	3	0/0	0/0	3

UNIT-I: BASIC CONCEPTS OF CLINICAL BIOCHEMISTRY **9Hrs**

A brief review of units and abbreviations used in expressing concentrations and standard solutions. specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens.

UNIT-II: DISEASES RELATED TO CARBOHYDRATE METABOLISM **9Hrs**

Regulation of blood sugar, Glycosuria - types of glycosuria. Oral glucose tolerance test in normal and diabetic condition. Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis.

UNIT-III: INBORN ERRORS OF METABOLISM INTRODUCTION **9Hrs**

Clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism and tyrosinemia, Haemophilia, Lipid and lipoproteins: Classifications, composition, mode of action - Cholesterol. Factors affecting blood cholesterol level. Dyslipoproteinemias, IHD, atheroscelorosis, risk factor and fatty liver.

UNIT-IV: ORGAN FUNCTION TEST **9Hrs**

Liver function test: Metabolism of bilirubin, jaundice - types, differential diagnosis. Icteric index, Vandenberg test, plasma protein changes, PTT. Renal function test : Clearance test – Urea, Creatinine, Insulin, PAH test, Concentration and dilution test. Gastric function test : Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis.

UNIT-V: CLINICAL ENZYMOLOGY **9Hrs**

Functional and non- Functional plasma enzymes. Isoenzymes with examples. Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting.

Total Hours: 45

TEXTBOOK

1. H. Varley, A. H. Gowenlock, and M. Bell (2006) *Practical Clinical Biochemistry* (6th Ed) London: Heinemann Medical Books,New Delhi (India) : CBS
2. Ramakrishnan(2001) Clinical biochemistry(3rd Ed) Orient Longman private Ltd.
3.Text book of Medical Biochemistry - Dr. M.N. Chatterjee and Rane Shinde

REFRENCES

1.Clinical chemistry – William Hoffman
2. Clinical Biochemistry with clinical correlation – Devin, Wiley
3. Practical clinical biochemistry – Harold Varley, CBS, New Delhi
4. Nessar Ahmed (2017) Fundamentals of Biomedical Science, Second Edition, Oxford Press.
5. R.Swaminathan (2011) Handbook of Clinical Biochemistry,Second Edition,World Scientific

Subject Code: BBT17E10	Subject Name: Advances in Agricultural Biotechnology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant Biotechnology/RDNA/Genetics	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

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Subject Code: BBT17E10	Subject Name: Advances in Agricultural Biotechnology	T / L/ ETL	L	T / S.Lr	P/ R	C

OBJECTIVES: To understand the basic concept on Molecular breeding used in crop and farm animal. To known the basic details of molecular and biochemical plant disease resistance and its GE

COURSE OUTCOMES (COs) : At the end of studying this course the student

CO1	Get an idea about the Molecular and crop breeding
CO2	Know about the different methods of disease resistance
CO3	understand the process of Genetic engineering in plants

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	H	H	H	M	L	H
CO2	H	H	H	H	H	M	H	H	H	M	L	H
CO3	H	H	H	H	H	M	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

	Prerequisite: Plant Biotechnology/RDNA/Genetics	T	3	0/0	0/0	3

UNIT I: **MOLECULAR BREEDING** **9 Hrs**

Concept & methodology of different types of molecular markers, Role of molecular markers in crop and farm animal improvement,conservation of biodiversity, Marker assisted selection, QTL mapping.

UNIT II: **CHLOROPLAST GENETIC ENGINEERING** **9 Hrs**

Methodology application in herbicide resistance,production of biopharmaceuticals,edible vaccines, foreign gene expression, Limitations

UNIT III: MOLECULAR AND BIOCHEMICAL BASIS OF PLANT DISEASE RESISTANCE **9 Hrs**

signelling pathways, Protein kinase, virus induced gene silencing,Molecular basis of plant resistance to various abiotic stresses like drought, salinity, heavy metals, High temperature, etc

UNIT IV: GENETIC ENGINEERING OF PLANTS **9 Hrs**

Production of transgenic plant for fungal ,bacterial and viral disease resistance;Herbicide resistance, Drought and other abiotic stress resistance;Quality parameters: Modification of nitrogen fixing capabilities, gene pyramiding.

UNIT V: TRANSGENIC ANIMALS FOR BETTER FARMING, WHOLE GENOME CLONING, MOLECULAR FARMING **9 Hrs**

Use of plants and animals for production of neutraceuticals, edible vaccines & other desired products

TOTAL HOURS: 45

TEXT BOOKS

1. Agriculture Biotechnology by Arie altman. Marcel Dekker, inc. (2001)
2. Plants, Genes & Crop Biotechnology (2003) 2nd Edition by Chrispeels, M.J & Sadava D.E American Society of Plant Biologists, Jones and Bartlett Publishers,USA
3. Biochemistry and Molecular biology of Plants:Edited by Buchanan B.B., Gruissem W and Jones RL(2000) American society of plant biologists, USA.

REFERENCE BOOKS:

1. Tom Zinnen, Biotechnology and Food: Leader and Participant Guide, Daine Publishing (1994)
2. Sarah Elderidge, Food Biotechnology: Current Issues and Perspectives (2003)
3. Israel Goldberg, Biotechnology and Food Ingredients, (1991)
4. R. D. King, Food Biotechnology—1 (1987)
5. Dietrich W. Knorr, Food Biotechnology (1986)

Subject Code: BBT17E11	Subject Name: Biomaterials and Tissue Engineering	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: CellBiology/Tissue culture	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To introduce polymers as biomaterial types and their applications .To study about the tissue engineering process of cells and tissues and the regulatory issues regarding tissue engineering and its standardization

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Different types of Biomaterials
CO2	the different types of Biopolymers
CO3	understand the process of Tissue engineering and its regulatory aspects

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	H	H	H	H	H	M	M	H	H	M	L	H
CO2	H	H	H	H	H	M	M	H	H	M	L	H
CO3	H	H	H	H	H	M	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

DEPARTMENT OF BIOTECHNOLOGY

~~Subject Code: BBT17E11~~	~~Subject Name : Biomaterials and Tissue Engineering~~	~~T / L/ ETL~~	~~L~~	~~T / S.Lr~~	~~P/ R~~	~~C~~
	Prerequisite: Cell Biology/Tissue culture	T	3	0/0	0/0	3

UNIT I: INTRODUCTION **9 Hrs**

Introduction: Biomaterial types-Natural-Artificial biomaterial-Processing-Skin grafts-Organo-typic culture-Cell polymer bioreactor-Functional cell mammalian cell constructs.

UNIT II: NATURAL BIOPOLYMERS **9 Hrs**

Natural biopolymers: Introduction: Collagen, Chitosan, Sodium alginate, Hyaluronic acid, Fibrinogen-Stabilization Chemical modification-Copolymers-Scaffolds-Porous matrices-Tubules-Cell surface interaction.

UNIT III: SYNTHETIC POLYMERS **9 Hrs**

Synthetic polymers-Introduction: Aliphatic carbonate based polymers-Dioxepanone based polymers-Poly anhydrides-Poly amino acids-Hydrogels-Polymer scaffolds-Processing microencapsulation-Injectable polymers.

UNIT IV: ENGINEERING CELLS AND TISSUES **9 Hrs**

Engineering cells and tissues: Introduction-Reconstruction-Vascular grafts-Synthetic valves-Replacement-Bioartificial device-Engineering of tissues- Regenerative matrix-implants-Bi-layered skin constructs.

UNIT V: REGULATORY ISSUE AND STANDARDIZATION **9 Hrs**

Regulatory issue and standardization-Safety consideration-Effectiveness consideration-Regulatory activities of FDA-Standardization through the ASTM-future prospects-Ethics and responsibility.

Total no of Hours : 45

REFERENCE BOOK

1. Anthony Atala, Robert P. Lanza (2001) Methods of tissue engineering .Academic press

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Subject Code: BBT17E12	Subject Name : Environmental Toxicology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology/Solid hazardous waste water Management	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To know the toxic chemicals present in the environment and their mode of entry .To understand the presence of carcinogens insecticides present in the environment.

COURSE OUTCOMES (COs) :After studying this course the student would be able to

CO1	Understand the basic knowledge about toxic substances of the environment
CO2	Know about the mode of entry and carcinogenicity
CO3	Have an awareness about the Epidemiological issues

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	L	H	H	H	M	L	H
CO2	H	H	H	H	H	L	H	H	H	M	L	H
CO3	H	H	H	H	H	L	H	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code:	Subject Name: Environmental Toxicology	T / P / L	L	T / S.Lr	P/ R	C
BBT17E12	Prerequisite: Biochemistry/Microbiology/Solid hazardous waste water Management	T	3	0/0	0/0	3

UNIT I: TOXIC CHEMICALS IN THE ENVIRONMENT **9 Hrs**

Toxic chemicals in the environment - air, water & their effects, Pesticides in water, Biochemicals aspects of arsenic, cadmium, lead mercury, carbon monoxide, ozone and PAN pesticide.

UNIT II: MODE OF ENTRY **9 Hrs**

Mode of entry of toxic substance, biotransformation of xenobiotics detoxification

UNIT III: CARCINOGENS IN AIR **9 Hrs**

Carcinogens in air, chemical carcinogenicity, mechanism of carcinogenicity, Environmental carcinogenicity testing.

UNIT IV: INSECTICIDES **9 Hrs**

Insecticides, MIC effects, Concept of major, trace and Rare Earth Element (REE)- possible effects of imbalance of some trace elements

UNIT V: BIOGEOCHEMICAL FACTORS **9 Hrs**

Biogeochemical factors in environmental health. Epidemiological issues goiter, fluorosis, arsenic poisoning.

Total Hours : 45

TEXT BOOKS

1. G. S Sodhi (2009) *Fundamental Concepts of Environmental chemistry*, (3rd Ed) Alpha Science International.
2. Stanley E. Manhan (2009) *Principals of Environmental chemistry*,(9th Ed) CRC press.
3. Ming-Ho Yu, Environmental Toxicology: Biological and Health Effects of Pollutants, CRC Press (2000)

REFERENCE BOOKS

1. R.B. Philip (2005) *Environmental hazards & human health*, Lewis publishers, Boca Raton.
2. Raymond Niesink, Mannfred A.Hollinger & Jon De Vries ,(1996) *Toxicology - Principles & applications*. CRC Press.
3. Chatterjee (2009) *Parasitology*, (13th Ed) CBS
4. K. Perk (2013) *Preventive & Social medicines*,(22nd Ed) Banarsidas Bhanot Jabalpur publishers
5. David A. Wright, Environmental Toxicology, Cmabridge University press (2002)

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17E13	Subject Name: CANCER BIOLOGY	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology / Molecular Biology	T	0	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To understand the fundamentals of cancer biology regarding cell cycle, mutational changes in signaling molecules, types of cancer, early detection methods and cancer screening methods, etc

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the basic knowledge about toxic substances of the environment
CO2	Know about the mode of entry and carcinogenicity
CO3	Have an awareness about the Epidemiological issues

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	L	M	H	H	M	L	H
CO2	L	H	H	H	H	L	M	H	H	M	L	H
CO3	L	H	H	H	H	L	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3					
CO1	H	H	H					
CO2	H	H	H					
CO3	H	H	H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E13	Subject Name: CANCER BIOLOGY	L / T / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology / Molecular Biology	T	3	0/0	0/0	3

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY **9 Hrs**

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumor suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT II: PRINCIPLES OF CARCINOGENESIS **9 Hrs**

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER **9 Hrs**

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

UNIT IV: PRINCIPLES OF CANCERMETASTASIS **9 Hrs**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

UNIT V: NEW MOLECULES FOR CANCER THERAPY **9 Hrs**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy.

Total Hours: 45

TEXT BOOK

1. L M Franks and N M Teich. (1991)*"An Introduction Top Cellular And Molecular Biology Of Cancer",* Oxford Medical Publications,
2. Robin Hesketh, Introduction to Cancer Biology, Cambridge University Press (2013)
3. Raymond W. Ruddon, Cancer Biology, Oxford University Press,

REFERENCE BOOKS

1. Maly B.W.J,(1987) *" Virology A Practical Approach ",* IRLl Press, Oxford,
2. Dunmock N.J And Primrose S.B., (1988) *" Introduction To Modern Virology ",*Blackwell Scientific Publications, Oxford.
3. Roger J. B. King, Cancer Biology, Prentice Hall (2000)
4. Maika G. Mitchell, Cell Biology: Translational Impact in Cancer Biology and Bioinformatics, Academic Press (2016)
5. Raymond W. Ruddon, Cancer biology, Oxford University Press (1995)

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Subject Code: BBT17E14	Subject Name : BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Immunology/IMA	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To understand the fundamentals of biosensors and types of biosensors. To study the uses of clinical and non-clinical uses of biosensors. To study the concepts behind the reagentless biosensors & array-based chips.

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Know the fundamental and types of Biosensors.
CO2	Know about the clinical and Non clinical uses of Biosensors.
CO3	Have awareness about the non reagent biosensors and chipbased Biosensors.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	H	H	H	L	M	H	H	M	L	H
CO2	L	H	H	H	H	L	M	H	H	M	L	H
CO3	L	H	H	H	H	L	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E14	Subject Name: Biosensors and biomedical devices in diagnostics	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Immunology/IMA	T	3	0/0	0/0	3

UNIT I: FUNDAMENTALS OF BIOSENSORS **9Hrs**

Biosensors as Functional Analogs of Chemo receptors- Immobilization and biosensor construction, Biosensor instrumentation-Transduction principles used in a biosensor, Biocomponent of the sensor. Biological sensing elements and transducer systems- their sensitivity specificity and linearity.

UNIT II: TYPES OF BIOSENSORS **9 Hrs**

Thermometric Indication with Thermistors, Opto electronic Sensors, Piezoelectric Sensors, Electrochemical Sensors, Potentiometric Electrodes, Amperometric Electrodes, Conductometric Measurement. Flow injection analysis based biosensors, fiber optics biosensors, Bioluminescence biosensors, Microbial biosensors, Affinity biosensors, immunosensors.DNA Probes, organic acid probes, antigen-antibodies reaction, biochemical detection of organelles, receptors, sensors for pollution gases stability and reusability of sensors.

UNIT III: BIOSENSORS FOR CLINICAL ANALYSIS **9 Hrs**

Biosensors for personal diabetes management (Glucose, Galactose, Gluconate, Lactate, Pyruvate Sensors) Noninvasive Biosensors in Clinical analysis and health care.

UNIT IV: NON CLINICAL APPLICATION OF BIOSENSORS **9 Hrs**

Applications in Veterinary, Agriculture, Food production, Environmental control and pollution monitoring, and bioprocess industry.

UNIT V: REAGENTLESS BIOSENSORS & ARRAY-BASED CHIPS **9Hrs**

Surface Dielectric Enhancement, Gold nanoparticle enhanced surface plasmon resonance, carbon nanotube and silicon nanowire enhanced conductivity, catalytic activation, electro catalytic detection, catalytically enabled optical and magnetic detection, Reagent less Immunoelectrodes, biomolecule conformational modulated effects, Biosensors based on DNA conformation changes, Biosensors based on protein conformation changes

Total Hours: 45

TEXT BOOKS

1. Turner A.P.F, Karube I and Wilson G.S, (1987) *Biosensors- Fundamentals and applications,* Oxford Univ.Press.
2. Ashutosh Tiwari, Biomedical Materials and Diagnostic Devices, Wiley Publication (2012)
3. Roger J Narayan, Medical Biosensors for Point of Care (POC) Applications (2016)

REFERENCE BOOKS

1. Yang V.C. and T.T.Ngo,(2000) *Biosensors and their Applications,* Academic/Plenum Publishers.
2. Ashok Mulchandani and Kim R Rogers,(1998)*Enzyme and Microbial bio sensors: Techniques and Protocols*,Humana Press Totowa, NJ.
3. Turner A.P.F and Wilsons G.S, (1997) *Biosensors: Fundamentals and Applications,* Oxford Science Publications.
4. Ramaier Narayanaswamy, Optical Sensors: Industrial Environmental and Diagnostic Applications
5. Lazakidou, Handbook of Research on Informatics in Healthcare and Biomedicine, IGI (2006)

Subject Code: BBT17E15	Subject Name: CLINICAL GENETICS AND CYTOGENETICS	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To understand the fundamentals of Human cytogenetics and malfunctions of genes in different genetic disorders. To study the different analytical techniques used for studying genetic disorders.

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Know the genetic basis of different diseases
CO2	Know about the different types of banding of chromosomes which helps in the diagnosis of genetic disorders
CO3	Have awareness about the specialized techniques using different probes.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	L	H	H	H	H	L	M	H	H	M	L	H
CO2	L	H	H	H	H	L	M	H	H	M	L	H
CO2	L	H	H	H	H	L	M	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3					
CO1	H	H	H					
CO2	H	H	H					
CO3	H	H	H					

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

Subject Code: BBT17E15	Subject Name: Clinical Genetics and Cytogenetics	Category: ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	T	3	0/0	0/0	3

INHERITANCE PATTERN INMAN:
Mendelian inheritance, dominant, recessive, lethal, sex linked, sex influenced, multifactorial and mitochondrial inheritance. Genetic Diseases of heart, lungs, Kidney, brain and sex organs.

CHROMOSOME BASIS OF INHERITANCE:
Autosomal, sex and micro chromosomal anomalies, cytogenetic techniques and nomenclature of banded chromosomes, ISCN 1980, 1990.

BANDING TECHNIQUE:
Differential staining: Q-Banding, G- banding, R-banding, Acridine orange R-banding, Cbanding, DAPI, C-banding, NOR banding.

SPECIALIZED TECHNIQUE:
HRB, chromosome Fragile sites, PCC (premature chromosome condensation), Karyotype interpretation classification of unbanded chromosomes, Nomenclature of banded mitotic chromosomes, HRB nomenclature.

PREPARATION OF PROBES:
Chromosome analysis by flowcytometry Instrument - Chromosome preparation/ flowsorting and library construction, restriction digestion, amplification techniques, labeling techniques, haptens, fluorochromes, counterstaining and hybridization protocol.Microdissection probe construction. **IN- SITU HYBRIDIZATION: I**sotopic and nonisotopic in situ hybridization (ISH, DISH, FISH, PRINS)

PROBE CLASSIFICATION: Specific locus probes, telomeric and centromeric probes and whole chromosome probes.Metaphase chromosome (chromosome painting), interphase nuclei (interphase FISH),extended chromatin fibres (fiber FISH), mFISH, mBAND, CGH,MPIL, Rx FISH, SKYFISH.Hybridization protocol, acquiring of image analysis

APPLICATION OF FISH:
Microdissection, species matching, human gene mapping, dosimetry, interphase cytogenetics, cancer studies clinical disorders etc.Chromosome in clinical medicine: classical chromosome syndromes, cytogenetics of spontaneous abortion, CAin prenatal diagnosis, CAin normal in mental retardations.
Genomic imprinting and RFLP.

TEXT BOOKS

1. Human chromosome principle and techniques, Second edition, by Ram S.Verma and Arvind Babu,Mac Grwall-Hill (1995)
2. Human Cytogenetics, Volume I constitutional analysis – a practical Approach, editor D. E. Rooney and B.H. Czepulkowski, IRL Press (1992)
3. Human cytogenetics, Volume IIMalignancy & Acquired Abnormalities- a

REFERENCE BOOKS:

1. practical approach, Editor D.E. Rooney, B.H. Czepulkowski, IRL Press (1992)
2. In situ hybridization- Apractical approach, second edition, Editor D.G.Wilkson, Oxford university Press (1999)
3. Principles and Practice of Medical Genetics Volume I and II, Editors, Emery and Rimoin, Churchill Liningstone (1991)
4. Medical Genetics, Jorde et al,Mosby Publisher (1997)
5. Scientific AmericanMolecular Oncology, Editor J.Michael Bishop and Robert A.

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17E16	Subject Name : LEGAL ASPECTS OF BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant biotechnology,Basic pharmaceutical science	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To gain knowledge about the importance of IPR ,To learn the process involved in patenting and claims To understand the requirements of disclosure and patent litigation. They have to also gain knowledge in biosafety and bioethics requirements

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	The IPR issues related to biotechnology products
CO2	About the basics of patents and concept of prior art and
CO3	And be Familiar about the biosafety and bioethics requirements for carrying out research work.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

Subject Code: BBT17E16	Subject Name: Legal Aspects of Biotechnology	Category: ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant Biotechnology, Basic Pharmaceutical Science	T	3	0/0	0/0	3

UNIT I: INTRODUCTION TO INTELLECTUAL PROPERTY **9 Hrs**

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design Protection of GMOs, IP as a factor relevance to Biotechnology and few Case Studies;

UNIT II: AMENDMENTS AND AGREEMENT **9 Hrs**

History of GATT & TRIPS Agreement; Madrid Agreement; Hague, Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent, Act 1970 & recent amendments.

UNIT IV: BIOSAFETY **9 Hrs**

Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals.

UNITV: BIOETHICS **9 Hrs**

Human genome project and its ethical issues. Gene testing, prenatal diagnosis, genetic manipulations, germline therapy, genetic studies on ethnic races.

Total no of Hours : 45

TEXTS/REFERENCES

1. BAREACT, (2007) *Indian Patent Act 1970 Acts & Rules*, Universal Law Publishing Co. Pvt. Ltd.,
2. Kankanala C.(2007*) Genetic Patent Law & Strategy*, (1st Ed), Manupatra Information Solution Pvt. Ltd.,

IMPORTANT LINKS:

1. http://www.w3.org/IPR/
2. http://www.wipo.int/portal/index.html.en
3. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
4. www.patentoffice.nic.in

DEPARTMENT OF BIOTECHNOLOGY

OPEN ELECTIVES

B.TECH Regulation 2017 Approved by the Academic Council 21.06.2017

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE1	Subject Name : FOOD AND NUTRITION	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: Understanding relationship between food, nutrition and health

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand about the nutritional significance of carbohydrate
CO2	Understand the nutritive and caloric value of food
CO3	Know about the deficiency of vitamins , micro and macro nutrients

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO O1**	**PO O2**	**PO3 3**	**PO O4**	**PO O5**	**PO O6**	**PO O7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						

Approval	

Subject Code: BBT17OE1	Subject Name : Food and Nutrition	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

UNIT-I: BASIC TERMS USED IN STUDY OF FOOD AND NUTRITION **9Hrs**

Understanding relationship between food, nutrition and health. Concept of Balanced Diet, Food Groups, Food Pyramid

UNIT-II: NUTRITIONAL SIGNIFICANCE OF CARBOHYDRATES **9Hrs**

protein, lipids, vitamins and minerals. Protein malnutrition (Kwashiorkar) and under nutrition (marasmus) and their preventive, curative measures.

UNIT-III: NUTRITIVE AND CALORIFIC VALUE OF FOOD **9Hrs**

Unit of energy measurements of food stuffs by Bomb colorimeter, calorific value and RQ of food stuffs. Basic metabolic rate (BMR), its measurements and influencing factors, SDA of food. Nutritive value of protein, essential amino acid. Composition of balanced diet for infants, pregnancy and lactating women, old age.

UNIT-IV: STRUCTURE , CLASSIFICATION **9Hrs**

Biochemical function and deficiency diseases of Vitamins

UNIT-V: STRUCTURE , CLASSIFICATION **9Hrs**

Biochemical function and deficiency diseases of Micro and Macro nutrients.

Total Hours: 45

TEXT BOOK

1.Anita Tull (1996). Food and Nutrition.Third Edition. Oxford University Press.
2. Jenny Ridgwell (1996). Examining Food and Nutrition.Heinemann.
3. Paul Fieldhouse (1995). Food and Nutrition.Second Edition, Published by Chapman & Hall.

REFERENCE

1.Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2.Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3.Srilakshmi,(2005), Dietetics, Revised 5th edition. New Age International Ltd.
4.Wardlaw MG, Paul M Insel Mosby (1996). Perspectives in Nutrition, Third Edition. Core Course ICMR.
5. Sumati R.Mudambi, M.V. Rajagopal (2001). Fundamentals of Foods and Nutrition. Fourth Edition. New Age International Publishers.

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE2	Subject Name : HUMAN PHYSIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :To learn about the various physiological mechanism involved in the human system

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the basic respiratory mechanism , circulatory and digestive system
CO2	Understand the excretory system
CO3	Understand the Endocrine and Nervous system

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO O1	PO O2	PO3 3	PO O4	PO O5	PO O6	PO O7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						

Subject Code: BBT17OE2	Subject Name : Human Physiology	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

UNIT-I: RESPIRATORY SYSTEM **9Hrs**

Components of transport of Oxygen and Carbon dioxide, Role hemoglobin in transport. Mechanism of respiration, Chloride shift, Bhor's effect.

UNIT-II: CIRCULATORY SYSTEM: **9Hrs**

Introduction, function, types, of Circulatory organ. Design of Blood vessels, Blood Flow, blood pressure, Cardiac muscle, ischemic disease.

UNIT-III: DIGESTIVE SYSTEM **9Hrs**

Components of Digestive system, Digestion, absorption of carbohydrates, protein, lipids. Mechanism of HCL formation, Role of various enzymes involved in digestive process

UNIT-IV: EXCRETORY SYSTEM **9Hrs**

Structure and function of kidney, Mechanism of urine formation, Glomerular filtration rate (GFR).

UNIT-V: ENDOCRINE AND NERVOUS SYSTEM **9Hrs**

Brief outline of various endocrine glands and their secretion, physiological role of hormones. Nervous system - Brain, spinal cord, nerve cells, and nerve fibers. Synapse, chemical and electrical synapses, nerve impulses, action potential and neurotransmission.

Total Hours: 45

TEXT BOOK

1. BJ Mejer, HS Meij, AC Meyer ,Human physiology, 2nd edition- AITBs publishers abd distributers.
2. K. Saradha subramanyam, S, A Hand Book of Basic Human physiology. Chand & Co., Ltd.
3. Y. Rajakshmi, S , Guide to physiology. Chand & Co., Ltd.

REFERENCE

1. Gillian Pocock, Christopher D. Richards, David A. Richards. Third Edition 2006. Oxford University Press.
2. David Wright,(2000) Human Physiology and Health. Heinemann Educational Publishers.
3.Laurence A. Cole, Peter R. Kramer (2016) Human Physiology, Biochemistry and Basic Medicine Academic Press –Elsevier.
4.Indu Khurana,(2009) Textbook of Medical Physiology. Published by Elsevier.
5.Joseph Feher, (2017) Quantitative Human Physiology an Introduction. Second Edition, Academic Press- Elsevier

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE3	Subject Name : CLINICAL BIOCHEMISTRY	T / L/ ETL	L	T / S.Lr	P/ R	C

	Prerequisite: Genetics/Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To study the basic concept of clinical biochemistry and to gain knowledge about the inborn error of metabolism.To have knowledge on the clinical enzymology study

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the disease related and inborn error in the metabolism
CO2	Understand the different organ test like liver test and gastric function test etc
CO3	Understand the Enzyme patterns in various function

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						
Approval												

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE3	Subject Name Clinical Biochemistry	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	T	3	0/0	0/0	3

UNIT-I: BASIC CONCEPTS OF CLINICAL BIOCHEMISTRY **9Hrs**

A brief review of units and abbreviations used in expressing concentrations and standard solutions. specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens.

UNIT-II: DISEASES RELATED TO CARBOHYDRATE METABOLISM **9Hrs**

Regulation of blood sugar, Glycosuria - types of glycosuria. Oral glucose tolerance test in normal and diabetic condition. Diabetes mellitus and Diabetic insipidus - hypoglycemia, hyperglycemia. Ketonuria, ketosis.

UNIT-III: INBORN ERRORS OF METABOLISM INTRODUCTION **9Hrs**

Clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism and tyrosinemia, Haemophilia, Lipid and lipoproteins: Classifications, composition, mode of action - Cholesterol. Factors affecting blood cholesterol level. Dyslipoproteinemias, IHD, atherosclerosis, risk factor and fatty liver.

UNIT-IV: ORGAN FUNCTION TEST **9Hrs**

Liver function test: Metabolism of bilirubin, jaundice - types, differential diagnosis. Icteric index, Vandenberg test, plasma protein changes, PTT. Renal function test : Clearance test – Urea, Creatinine, Insulin, PAH test, Concentration and dilution test. Gastric function test : Collection of gastric contents, examination of gastric residuum, FTM, stimulation test, tubeless gastric analysis.

UNIT-V: CLINICAL ENZYMOLOGY **9Hrs**

Functional and non- Functional plasma enzymes. Isoenzymes with examples. Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting.

Total Hours: 45

TEXTBOOK

1. H. Varley, A. H. Gowenlock, and M. Bell (2006) *Practical Clinical Biochemistry* (6th Ed) London: Heinemann Medical Books,New Delhi (India) : CBS
2. Ramakrishnan(2001) Clinical biochemistry(3rd Ed) Orient Longman private Ltd.
3.Text book of Medical Biochemistry - Dr. M.N. Chatterjee and Rane Shinde

REFRENCES

1.Clinical chemistry – William Hoffman
2. Clinical Biochemistry with clinical correlation – Devin, Wiley
3. Practical clinical biochemistry – Harold Varley, CBS, New Delhi
4. Nessar Ahmed (2017) Fundamentals of Biomedical Science, Second Edition, Oxford Press.
5. R.Swaminathan (2011) Handbook of Clinical Biochemistry,Second Edition,World Scientific Publishing Co.Pte.Ltd

Subject Code: BBT17OE4	Subject Name : PHARMACOGENOMICS	T / L / ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Genomics	T	0	0/0	0/0	3

DEPARTMENT OF BIOTECHNOLOGY

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: To learn about the basic of genetics and to gain knowledge of drug response mechanism. To have a deep knowledge of pharmacogenetics and its study on model organism.

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the analysis and methods of genetics
CO2	Understand the knowledge of Pharmacokinetics and pharmacodynamic
CO3	Understand the transporter system and to gain knowledge on the implications of pharmacogenetics healthcare delivery.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	H	H	H	H	M	M	H	L	L	L	H
CO2	M	H	H	H	H	M	M	H	L	L	L	H
CO3	M	H	H	H	H	M	M	H	L	L	L	H

COs / PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	H	H	H
CO2	H	H	H
CO3	H	H	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						
Approval												

Subject Code: BBT17OE4	Subject Name: Pharmacogenomics	Category	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Genomics	T	0	0/0	0/0	3

UNIT I: PHARMACOGENOMICS OVERVIEW AND BACKGROUND **9Hrs**

Genetics Linkage analysis: Classic examples of pharmacogenetics, pedigrees, recessive traits, positional cloning of drug induced arrhythmia gene (Long QT); genetic polymorphisms and maps.

UNIT II: ANALYSIS AND METHODS **9Hrs**

Association analysis; beta receptor polymorphism, criteria for successful association analysis (power analysis, choice of cases and controls, Hardy-Weinberg equilibrium), application to pharmacogenetics; candidate gene versus whole genome association studies; haplotypes versus individual markers.Genomics expression arrays to study drug response; SNP genotyping methods and technology

UNIT III: DETERMINANTS OF DRUG RESPONSE **9Hrs**

Pharmacokinetics and pharmacodynamic factors involved in drug response, gender and ethnic differences in drug response, molecular mechanisms for alterations in drug response.Enzymes: Thiopurine methyltransferase deficiencies, pedigree analysis, autosomal recessive traits, CYP 2D6 polymorphisms, genetic basis of polymorphisms, effects on drug response

UNITIV: PHARMACOGENETICS **9Hrs**

Transporters: MDR1 studies in knockout mice, human polymorphisms, effects on drug response, haplotypes, Other transporter polymorphisms.Transcription factors: Nuclear receptors, PXR, FXR and CAR.Implications of pharmacogenetics healthcare delivery; ethics and clinical study design:Cost of pharmacogenetic testing to process and to costs, types of clinical protocols, consent forms, the Committee on Human Research, ethical implications of pharmacogenetic studies.

UNIT V: MODEL ORGANISMS IN PHARMACOGENETIC STUDIES **9Hrs**

Uses of yeast, *C. elegans*, zebrafish and mice in pharmacogenetic studies; pharmacogenomics as a public health tool; nonscientific challenges for pharmacogenomics.

Total Hours: 45

TEXTBOOKS

1. Howard L McLeod1 andWilliam E Evans (2001). Pharmacogenomics Unlocking the Human Genome for Better Drug Therapy. Annu. Rev. Pharmacol. Toxicol.2001. 41:101–21
2. Evans WE, RellingMV. 1999. : pharmacogenomicstranslating functional genomics into rational therapeutics. *Science* 286:487
3. Satoskar, R.S., Bhandarkar, S.D and Annapure, S.S (1999), Pharmacology and pharmacotherapeutics, popular prakashan, Mumbai.

REFERENCES

1. Mycek, J., Harvey, A.R and Champe, P.C (1997), Pharmacology, 2nd edition,Williams and Wilkins publishers.
2. Werner kalow, Urs A.Meyer and Rachel F.Tyndale,(2001), Pharmacogenomics.
3. Russ B.Altman, David Flockhart and David B. Goldstein, (2012), Principles of Pfharmacogenetics and Pharmacogenomics. Cambridge University Press.
4. Martin M.Zdanowicz, (2010), Concepts in Pharmacogenomics, American Society of Health-System Pharmacists.
5. Y.M Francis Lam,Larisa H.Cavallari (2013),Pharmacogenomics –Challenges and Opportunities in Therapeutic Implementation.

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DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE5	Subject Name : BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES : To study the biosensors based on DNA conformation changes, Biosensors based on protein conformation changes

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the biosensors as functional analogs of chemo receptors
CO2	Gain knowledge on the types of biosenors and its application in the clinical field
CO3	Understand the basic principles involved in the non clinical biosensors in various field and other reagent less biosensors and array based chips

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO O1	PO O2	PO3 3	PO O4	PO O5	PO O6	PO O7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H
CO2	M	H	H	H	H	M	H	H	L	L	L	H

COs / PSOs	PSO1	PSO2	PSO3						
CO1	H	H	H						
CO2	H	H	H						
CO3	H	H	H						

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
						✓						
Approval												

DEPARTMENT OF BIOTECHNOLOGY

Subject Code: BBT17OE05	Subject Name : Biosensors and biomedical devices in diagnostics	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	T	3	0/0	0/0	3

UNITI: FUNDAMENTALS OF BIOSENSORS **9Hrs**

Biosensors as Functional Analogs of Chemo receptors- Immobilization and biosensor construction, Biosensor instrumentation-Transduction principles used in a biosensor, Biocomponent of the sensor. Biological sensing elements and transducer systems- their sensitivity specificity and linearity.

UNIT II: TYPES OF BIOSENSORS **9Hrs**

Thermometric Indication with Thermistors, Opto electronic Sensors, Piezoelectric Sensors, Electrochemical Sensors, Potentiometric Electrodes, Amperometric Electrodes, Conductometric Measurement. Flow injection analysis based biosensors, fiber optics biosensors,Bioluminescence biosensors, Microbial biosensors, Affinity biosensors, immunosensors.DNA Probes, organic acid probes, antigen-antibodies reaction, biochemical detection of organelles, receptors, sensors for pollution gases stability and reusability of sensors.

UNIT III: BIOSENSORS FOR CLINICAL ANALYSIS **9Hrs**

Biosensors for personal diabetes management (Glucose, Galactose, Gluconate, Lactate, Pyruvate Sensors) Noninvasive Biosensors in Clinical analysis and health care.

UNIT IV: NON CLINICAL APPLICATION OF BIOSENSORS **9 Hrs**

Applications in Veterinary, Agriculture, Food production, Environmental control and pollution monitoring, and bioprocess industry.

UNIT V: REAGENTLESS BIOSENSORS & ARRAY-BASED CHIPS **9Hrs**

Surface Dielectric Enhancement, Gold nanoparticle enhanced surface plasmon resonance, carbon nanotube and silicon nanowire enhanced conductivity, catalytic activation, electro catalytic detection, catalytically enabled optical and magnetic detection, Reagent less Immunoelectrodes, biomolecule conformational modulated effects, Biosensors based on DNA conformation changes, Biosensors based on protein conformation changes

Total Hours: 45

TEXT BOOK

1.Turner A.P.F, Karube I and Wilson G.S, (1987) Biosensors- Fundamentals and applications, Oxford Univ.Press.
2.Yang V.C. and T.T.Ngo,(2000) Biosensors and their Applications, Academic/Plenum Publishers.
3.Ashok Mulchandani and Kim R Rogers,(1998)Enzyme and Microbial bio sensors: Techniques and Protocols,Humana Press Totowa, NJ.

REFERENCE BOOKS

1. Turner A.P.F and Wilsons G.S, (1997) Biosensors: Fundamentals and Applications, Oxford Science Publications
2. Zoraida P.Aguilar (2013),Nanomaterials for Medical Applications,Elsevier
3. Roger J Narayan (2017), Medical Biosensors for Point of care (POC) applications, Wood Publishing –Elsevier.
4.Ashutosh Tiwari, Murugan Ramalingam,Hisatoshi Kobayashi, Anthony P.F Turner (2013), Biomedical Materials and Diagnostic Devices
5.Keith E. Herold, Avraham Rasoly, (2012), Biosensors and Molecular Technologies for Cancer Diagnostics,CRC Press.