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

B.Tech Regulation - 2018

Curriculum & Syllabus

B.Tech. Biotechnology (Full Time)

Curriculum – 2018 Regulation

I SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BEN18001	Technical English –I	2	1	0/0	2/0	Ty
2	BMA18002	Bio Mathematics	4	3	1/0	0/0	Ty
3	BPH18001	Engineering Physics –I	3	2	0/1	0/0	Ty
4	BCH18001	Engineering Chemistry –I	3	2	0/1	0/0	Ty
5	BES18001	Basic Electrical & Electronics Engineering	3	2	0/1	0/0	Ty
6	BES18002	Basic Mechanical & Civil Engineering	3	2	0/1	0/0	Ty
PRACTICALS*							
1	BES18L01	Basic Engineering Workshop	1	0	0/0	2/0	Lb
2	BES18ET1	Orientation to Entrepreneurship & Project Lab	1	0	0/0	2/0	ETL

Credits Sub Total: 20

II SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BMA18004	Bio Statistics	4	3	1/0	0/0	Ty
2	BPH18002	Engineering Physics –II	3	2	0/1	0/0	Ty
3	BCH18002	Engineering Chemistry – II	3	2	0/1	0/0	Ty
4	BES18003	Environmental Science*	NON CREDIT COURSE				Ty
PRACTICALS*							
1	BEN18ET1	Communication Lab	1	1	0/0	2/0	ETL
2	BES18ET2	Basic Engineering Graphics	2	1	0/0	2/0	ETL
3	BES18L02	Integrated Physical Science Lab	1	0	0/0	2/0	Lb
4	BES18ET3	C Programming and Lab	2	1	0/0	2/0	ETL

Credits Sub Total: 16
TOTAL CREDITS: 36

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

III SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18001	Biochemistry	4	3	1/0	0/0	Ty
2	BBT18002	Microbiology	4	3	1/0	0/0	Ty
3	BBT18003	Enzyme Technology	3	3	0/0	0/0	Ty
4	BBT18004	Thermodynamics and Stoichiometry	3	3	0/0	0/0	Ty
5	BCS18I04	Object Oriented Programming for Biotechnologists	3	3	0/0	0/0	Ty
PRACTICALS*							
1	BBT18L01	Biochemistry Lab	1	0	0/0	3/0	Lb
2	BBT18L02	Microbiology Lab	1	0	0/0	3/0	Lb
3	BCS18IL4	Object Oriented Programming Lab	1	0	0/0	3/0	Lb

Credits Sub Total: 20

IV SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BMA18015	Advanced Mathematics for Biotechnologists	4	3	1/0	0/0	Ty
2	BBT18005	Instrumentation and Biophysics	4	3	1/0	0/0	Ty
3	BBT18006	Microbial Biotechnology	3	3	0/0	0/0	Ty
4	BCS18I05	Bio Database Systems	3	3	0/0	0/0	Ty
5	BHS18NC1/ BHS18NC2	The Indian Constitution*/ The Indian Traditional Knowledge*	NC	2	0/0	0/0	Ty
PRACTICALS*							
1	BHS20ET5	Universal Human Values 2:Understanding Harmony	3	1	0/1	3/0	ETL
2	BBT18L03	Instrumental Methods of Analysis Lab	1	0	0/0	3/0	Lb
3	BBT18L04	Microbial Biotechnology Lab	1	0	0/0	3/0	Lb
4	BCS18IL5	Bio Database Systems Lab	1	0	0/0	3/0	Lb
5	BBT18TS1	Technical Skill 1	1	0	0/0	3/0	Lb
6	BEN18SK1	Soft Skill I (Career & Confidence Building)	1	0	0/0	3/0	ETL

Credits Sub Total: 22

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

V SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18008	Molecular Biology and Recombinant DNA Technology	4	3	1/0	0/0	Ty
2	BEI18I03	Bioprocess Instrumentation and Control	3	3	0/0	0/0	Ty
3	BBT18009	Immunology	3	3	0/0	00	Ty
4	BXX18OEX	Open Elective	3	3	0/0	00	Ty
PRACTICALS*							
1	BBT20ET6	Cell Biology & Genetics	3	1	0/1	3/0	ETL
2	BBT18L05	Immunology Lab	1	0	0/0	3/0	Lb
3	BBT18L06	Molecular Biology Lab	1	0	0/0	3/0	Lb
4	BEI18IL3	Bioprocess Control Systems Lab	1	0	0/0	3/0	Lb
5	BBT18TS2	Technical Skill 2	1	0	0/0	3/0	Lb

Credits Sub Total: 20

VI SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18010	Bioprocess Engineering	4	3	1/0	0/0	Ty
2	BBT18011	Bioinformatics	4	3	1/0	0/0	Ty
3	BXX18EXX	Elective I	3	3	0/0	0/0	Ty
4	BXX18OEX	Open Elective	3	3	0/0	0/0	Ty
PRACTICALS*							
1	BBT18ET3	Plant Biotechnology	3	1	0/1	3/0	ETL
2	BEN18SK2	Soft Skill II (Qualitative and Quantitative Skills)	1	0	0/0	3/0	ETL
3	BBT18L07	Bioprocess Lab	1	0	0/0	3/0	Lb
4	BBT18L08	Bioinformatics Lab	1	0	0/0	3/0	Lb
5	BBT18L09	Mini Project/In plant Training/Industrial training	1	0	0/0	3/0	Lb
6	BBT18TS3	Technical Skill 3	1	0	0/0	3/0	Lb

Credits Sub Total: 22

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

VII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18012	Downstream Processing	4	3	1/0	0/0	Ty
2	BXX18EXX	Elective – II	3	3	0/0	0/0	Ty
3	BXX18EXX	Elective –III	3	3	0/0	0/0	Ty
4	BMG18004	Total Quality Management for Biotechnologists	3	3	0/0	0/0	Ty
PRACTICALS*							
1	BBT18ET4	Food Biotechnology	3	1	0/1	3/0	ETL
2	BBT18L10	Downstream Processing Lab	1	0	0/0	3/0	Lb
3	BBT18L11	Animal Tissue Culture Lab	1	0	0/0	3/0	Lb
4	BBT18L12	Project Phase –I	2	0	0/0	3/3	Lb
5	BHS18FLX	Foreign Language	1	0	0/0	3/0	Lb
6	BXX18OLX	Open Lab	1	0	0/0	3/0	Lb

Credits Sub Total: 22

VIII SEMESTER							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18013	Legal Aspects of Biotechnology	4	3	1/0	0/0	Ty
2	BXX18EXX	Elective-IV	3	3	0/0	0/0	Ty
3	BXX18EXX	Elective-V	3	3	0/0	0/0	Ty
PRACTICALS*							
1	BBT18L14	Project Phase – II	8	0	0/0	12/12	L

Credits Sub Total: 18

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

ELECTIVE -I							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18E01	Herbal Drug Technology	3	3	0/0	0/0	Ty
2	BBT18E02	Environmental Impact Assessment	3	3	0/0	0/0	Ty
3	BBT18E03	Stem Cells and Developmental Biology	3	3	0/0	0/0	Ty

ELECTIVE -II							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18E04	Protein Science	3	3	0/0	0/0	Ty
2	BBT18E05	Bio Fuels	3	3	0/0	0/0	Ty
3	BBT18E06	Solid and Hazardous Waste Management	3	3	0/0	0/0	Ty

ELECTIVE –III							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18E07	Cancer Biology	3	3	0/0	0/0	Ty
2	BBT18E08	Molecular Pathogenesis	3	3	0/0	0/0	Ty
3	BBT18E09	Marine Biotechnology	3	3	0/0	0/0	Ty
4	BBT18E10	Animal Tissue Culture	3	3	0/0	0/0	Ty

ELECTIVE –IV							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18E11	Advances in Agricultural Biotechnology	3	3	0/0	0/0	Ty
2	BBT18E12	Biomaterials and Tissue Engineering	3	3	0/0	0/0	Ty
3	BBT18E13	Environmental Toxicology	3	3	0/0	0/0	Ty
4	BBT18E14	Pharmaceutical Technology	3	3	0/0	0/0	Ty

ELECTIVE -V							
S.NO.	**SUBJECT CODE**	**SUBJECT NAME**	**C**	**L**	**T/ SLr**	**P/R**	**Ty/ Lb/ ETL**
1	BBT18E15	Biosensors and Biomedical Devices in Diagnostics	3	3	0/0	0/0	Ty
2	BBT18E16	Clinical Genetics and Cytogenetics	3	3	0/0	0/0	Ty
3	BBT18E17	Bioremediation of Industrial Effluents	3	3	0/0	0/0	Ty

CREDIT SUMMARY

Semester 1 : 20 Credits
Semester 2 : 16 Credits
Semester 3 : 20 Credits
Semester 4 : 22 Credits
Semester 5 : 20 Credits
Semester 6 : 22 Credits
Semester 7 : 22 Credits
Semester 8 : 18 Credits

TOTAL CREDITS - 160

SEMESTER - I

DEPARTMENT OF ENGLISH

Subject Code : **BEN18001**	Subject Name : **TECHNICAL ENGLISH - I**	**TY / L/ ETL**	**L**	**T / S. Lr**	**P/ R**	**C**
	Prerequisite : None	TY	**1**	**0/ 0**	**2/0**	**2**

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

OBJECTIVES :

- Strengthen their vocabulary in both technical and business situations
- Get practice in functional grammar
- Learn the effective way of corresponding with officials
- Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages.
- Train learners in organized academic and professional writing

COURSE OUTCOMES (Cos) : (3 – 5)
Students completing the course would be 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; interpret the advertisements and prepare the resume relevantly
CO4	Learn to give instructions, suggestions, recommendations and comprehend and infer the information from the given passages/ reports
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				**3**						**3**		**3**
CO2				**3**						**3**		**3**
CO3				**3**		**2**				**3**		**3**
CO4				**3**						**3**		**3**
CO5				**3**						**3**		**3**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BEN18001**	Subject Name : **TECHNICAL ENGLISH - I**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	TY	**1**	**0/0**	**2/0**	**2**

UNIT I - VOCABULARY BUILDING **6 Hrs**

The concept of Word Formation-Root words and affixes from foreign languages and their use in English to form derivatives.-Homophones- Words often confused-Verbal analogy

UNIT II - BASIC WRITING SKILLS **6 Hrs**

Using Idioms and phrases in sentences-Sentence structures: statements, interrogative and imperative-Use of Conditional/if' clauses in sentences-Importance of proper punctuation-Creating coherence with sentence markers-Organizing coherent paragraphs in essays

UNIT III - IDENTIFYING COMMON ERRORS IN WRITING **6 Hrs**

Subject-verb agreement-Noun-pronoun agreement- Misplaced modifiers-Articles-Prepositions-Redundancies and Clichés

UNIT IV - WRITING PRACTICE- NATURE AND STYLE OF TECHNICAL WRITING **6 Hrs**

Describing Gadgets- Defining Concepts-Classifying data-Comprehension-Essay Writing-Informal and Formal Letter Writing:

UNIT V - ORAL COMMUNICATION AND INTERACTIVE LEARNING **6 Hrs**

(This unit involves interactive practice sessions in Language Lab)
Activities to develop knowledge in Word formation, Vocabulary and analytical thinking-Instructions and –Recommendations-Formal and Informal Registers in Speech-Listening and taking notes

Total no. of periods: 30

TEXT BOOK:

Quest: A Textbook of Communication Skills, Vijay Nicole, 2017.
Pushkala, R, Padmasani Kannan S, Anuradha V, Chandrasena M Rajeswaran

SUGGESTED READINGS:

(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. Macmillan.2007
(iii)*On Writing Well.* William Zinsser. Harper Resource Book. 2001
(iv) *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(vi) *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press
(vi) Pronunciation in Use ,Mark Hancock. Cambridge University Press. 2012

DEPARTMENT OF MATHEMATICS

Subject Code : **BMA18002**	Subject Name :**BIO MATHEMATICS**	**TY / L/ ETL**	**L**	**T / S. Lr**	**P/ R**	**C**
	Prerequisite : None	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

OBJECTIVES :

- Use the Basic concepts in Matrices
- Understand the Basic concepts in Differentiation
- Understand the Basic concepts in Integration
- Apply the Basic concepts in Interpolation
- 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**	**PO 9**	**PO 10**	**PO 11**	**PO12**
CO1	**3**	**3**			**2**	**2**			**3**	**3**		**3**
CO2	**3**	**3**			**3**	**1**						**3**
CO3	**3**	**3**			**2**				**2**	**3**		**1**
CO4	**3**	**3**			**1**	**2**			**2**	**3**		**3**
CO5	**3**	**3**				**2**			**2**	**2**		**3**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BMA18002**	Subject Name :**BIO MATHEMATICS**	**TY / L/ ETL**	**L**	**T / S. Lr**	**P/ R**	**C**
	Prerequisite : None	TY	**3**	**1/0**	**0/0**	**4**

UNIT I - MATRICES **12 Hrs**

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

UNIT II - DIFFERENTIATION **12 Hrs**

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

UNIT III - INTEGRATION **12 Hrs**

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).

UNIT IV - INTERPOLATION **12 Hrs**

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

UNIT V - NUMERICAL DIFFERENTIATION AND INTEGRATION **12 Hrs**

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 (5^{th} ed.), Elsevier Ltd, (2010).*

DEPARTMENT OF PHYSICS

Subject Code: **BPH18001**	Subject Name : **ENGINEERING PHYSICS - I**	**TY / L/ ETL**	**L**	**T / S.L r**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**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 :

- Outline the relation between Science, Engineering & Technology.
- Demonstrate competency in understanding basic concepts.
- Apply fundamental laws of Physics in Engineering & Technology.
- To identify & solve problems using physics concepts.
- 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	**3**	**3**		**2**	**2**	**2**						
CO2	**3**	**3**	**2**	**2**	**2**	**2**			**2**	**2**		
CO3	**3**	**3**	**3**	**2**	**2**	**2**				**2**		**2**
CO4	**3**	**3**	**2**	**2**		**2**			**2**	**2**		**2**
CO5	**3**	**3**	**2**			**2**		**2**				**1**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BPH18001**	Subject Name : **ENGINEERING PHYSICS - I**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**0/0**	3

UNIT I - MECHANICS & PROPERTIES OF MATTER **9 Hrs**

Mechanics : Introduction- scalar and vector quantities - rigid body - moment of inertia - forces in nature - Newton's laws of motion - derivation of Newton's second law of motion - motion of rocket – dynamical concepts - kinematics - conservation of energy and momentum - conservative and non-conservative forces - mechanics of continuous media - friction and its applications.

Properties of Matter: Elasticity - stress, strain and Hook's law - Poisson's ratio - three moduli of elasticity - twisting couple on a wire - viscosity - flow of liquid through a narrow tube: Poiseuille's law - Ostwald`s viscometer - flow of blood in human body.

UNIT II - SHM AND ACOUSTICS **9 Hrs**

SHM: Simple harmonic motion - differential equation of SHM - graphical representation of SHM - average kinetic energy of vibration - total energy of vibration - free and forced vibrations - damped and undamped vibrations - resonance - transverse wave on a string - law of transverse vibration of string - verification of the laws of transverse vibration of string - standing waves.

Acoustics : Fundamentals of acoustics - reverberation- reverberation time - factors affecting acoustics Ultrasonics - Production of ultrasonic waves - detection of ultrasonic waves - acoustic grating - application of ultrasonic waves.

UNIT III - WAVE OPTICS **9 Hrs**

Huygen`s principle - interference of light - wavefront splitting and amplitude - airwedge - Newton`s rings - Michelson interferometer and its applications - Fraunhofer diffraction from a single slit - Rayleigh criterion for limit of resolution - diffraction grating and resolving power of a telescope.

UNIT IV - ELECTROMAGNETIC THEORY **9 Hrs**

Electric field - coulomb`s law - alternating emf - rms and average value of an alternating current & voltage - resistors, capacitors and inductor - energy stored in a capacitor - LCR circuit & resonance – magnetism-definition - types - Biot Savart law - energy stored in a magnetic field - Domain theory - electromagnetic induction - self and mutual inductance - Faraday`s law of electromagnetic induction -Lenz law.

UNIT V - LASER **9 Hrs**

Laser principle and characteristics - amplification of light by population inversion - properties of laser beams: mono-chromaticity, coherence, directionality and brightness - different types of lasers - Ruby laser-Nd-YAG laser-He-Ne laser-CO_2 laser - semiconductor laser - applications of lasers in science, engineering and medicine.

Total No of Periods : 45

TEXT BOOKS

1. Brijlal, M. N. Avadhanulu & N. Subrahmanyam, Text Book of Optics, S. Chand Publications, 25th edition, 2012
2. R. Murugeshan, Electricity and Magnetism, S.Chand Publications, 10th edition, 2017
3. R. Murugeshan & Kiruthiga Sivaprasath, Modern Physics, S.Chand Publications, 2016

REFERENCE BOOKS

1. Dr. Senthil Kumar Engineering Physics I VRB Publishers, 2016
2. N Subrahmanyam & Brijlal, Waves and Oscillations, Vikas Publications, New Delhi,1988
3. N Subrahmanyam & Brijlal, Properties of Matter, S. Chand Co., New Delhi, 1982
4. N Subrahmanyam & Brijlal, Text book of Optics, S. Chand Co., New Delhi, 1989
5. R. Murugeshan, Electricity and Magnetism, S. Chand & Co., New Delhi, 1995
6. Thygarajan K & Ajay Ghatak, Laser Theory and Applications, Macmillan, New Delhi, 1981

DEPARTMENT OF CHEMISTRY

Subject Code : **BCH18001**	Subject Name : **ENGINEERING CHEMISTRY – I**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**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 :

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

COURSE OUTCOMES (Cos) : (1– 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	**3**	**3**										**2**
CO2	**3**	**3**	**2**	**3**		**3**	**3**					**2**
CO3	**3**	**2**	**3**				**1**					**1**
CO4	**3**		**1**	**3**								**1**
CO5	**3**											**2**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BCH18001**	Subject Name : **ENGINEERING CHEMISTRY – I**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**0/0**	**3**

UNIT I - CHEMICAL THERMODYNAMICS **8 Hrs**

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.

UNIT II - TECHNOLOGY OF WATER **9 Hrs**

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.

UNIT III - ELECTROCHEMISTRY AND ENERGY STORAGE DEVICES **10 Hrs**

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 PH using these electrodes.

Reversible and irreversible cells– Fuel cells- H2–O2 fuel cell, Batteries-Lead storage battery,Nickel–Cadmium and Lithium-Battery.

UNIT IV - CORROSION AND PROTECTIVE COATING **9 Hrs**

Introduction–Causes of Corrosion–Consequences- Factors affecting corrosion. Theories of corrosion-Chemical corrosion and Electrochemical corrosion. Methods of corrosion control – corrosion inhibitors, Sacrificial anode and Impressed current cathodic protection. Protective coatings- Metallic coatings-Chemical conversion coatings-paints-Constituents and functions.

UNIT V - POLYMERS AND COMPOSITES **9 Hrs**

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, fiber 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 : **BES18001**	Subject Name : **BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**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 :

- Understand the concepts of circuit elements, circuit laws and coupled circuits.
- Acquire knowledge on conventional &non conventional energy production.
- Gain information on measurement of electrical parameters.
- Identify basic theoretical principles behind the working of modern electronic gadgets.
- 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	**3**	**3**	**3**	**3**							**2**	**1**
CO2	**3**	**3**	**3**	**2**	**2**		**2**				**2**	
CO3	**3**	**2**	**3**	**2**	**3**		**2**		**2**			**1**
CO4	**3**	**2**		**2**			**2**				**2**	**1**
CO5	**3**	**2**	**3**	**2**	**3**				**2**		**2**	**1**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BES18001**	Subject Name : **BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**0/0**	**3**

UNIT I - ELECTRIC CIRCUITS **9 Hrs**

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.

UNIT II - MACHINES & MEASURING INSTRUMENTS **9 Hrs**

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.

UNIT III - BASICS OF POWER SYSTEM **9 Hrs**

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

UNIT IV - ELECTRON DEVICES **9 Hrs**

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

UNIT V - DIGITAL SYSTEM **9 Hrs**

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.*

DEPARMENT OF MECHANICAL ENGINEERING

Subject Code : **BES18002**	Subject Name : **BASIC MECHANICAL & CIVIL ENGINEERING**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**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 :

- Learn Basics of Internal Combustion Engines, power plants and boilers
- Demonstrate How metals are formed, joined, using machining operations Lathe, Milling and Drilling machines
- To identify & solve problems in Engineering Mechanics
- Learn basics of Building materials and construction
- 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	**3**					**2**		**3**	**3**	**3**		**3**
CO2	**3**				**1**	**2**		**2**	**2**	**2**		**2**
CO3	**3**	**3**			**1**	**1**		**2**	**2**	**2**		**2**
CO4	**3**				**1**	**1**			**2**	**2**		**2**
CO5	**3**				**1**	**1**		**2**	**2**	**2**		**2**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BES18002**	Subject Name : **BASIC MECHANICAL & CIVIL ENGINEERING**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**TY**	**2**	**0/1**	**0/0**	**3**

UNIT I - THERMAL ENGINEERING **9 Hrs**

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 Hrs**

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 Hrs**

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

UNIT IV - BUILDING MATERIALS AND CONSTRUCTION **7 Hrs**

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 Hrs**

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 ENGINEERING SCIENCES

Subject Code : **BES18L01**	Subject Name :**BASIC ENGINEERING WORKSHOP**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	Lb	**0**	**0/0**	**2/0**	**1**

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

OBJECTIVES :

- Familiarize the plumbing tools, fittings, carpentry tools, etc.
- Identify basic electrical wiring and measurement of electrical quantities.
- Identify Electronic components ,logic gates and soldering process
- Display simple fabrication techniques
- 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	**3**	**3**	**3**	**2**	**2**			**1**	**2**			**1**
CO2	**3**		**3**	**1**	**2**			**1**	**1**			
CO3	**3**		**2**	**1**				**1**	**1**			
CO4	**3**	**3**	**2**	**1**				**1**	**1**			**2**
CO5												

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : **BES18L01**	Subject Name :**BASIC ENGINEERING WORKSHOP**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	Lb	**0**	**0/0**	**2/0**	**1**

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. 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.
4. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
5. Fluorescent lamp wiring.
6. Stair case wiring

ELECTRONIC ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak- peak, rms period, frequency) using CRO
2. Soldering practice – Components Devices and Circuits – Using general purpose P

Abdul Kalam CoE for Innovation & Entrepreneurship

Subject Code : BES18ET1	Subject Name : ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	0	0/0	2/0	1

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

OBJECTIVES :

- Understand how entrepreneurship Education transforms individuals into successful leaders.
- Identify individual potential &S have career dreams
- Understand difference between ideas & opportunities
- Identify components & create action plan.
- 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	Identify the required skills for entrepreneurship & develop

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	2	3	2	2	2		2	2	2	1
CO2	3	2		3	2	3	2	3	3	3	2	2
CO3		2	2	2		3		3	3	3		
CO4		3	2	2	2	2		3	2	2	3	
CO5		2	2	3	2	2	3	3	2	2	3	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BES18ET1	Subject Name : ORIENTATION TO ENTREPRENEURSHIP & PROJECT LAB	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	**0**	**0/0**	**2/0**	**1**

UNIT I - 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 –

UNITII - ENTREPRENEURIAL STYLE

Entrepreneurial styles – Introduction, concept & Different types - Barrier to Communication – Body language speaks louder than words

UNIT III - DESIGN THINKING

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

UNIT IV - RISK MANAGEMENT

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 ?

UNIT V - PROJECT

How to choose a topic – basic skill sets necessary to take up a project – creating a prototype – Pitch your project – Project presentation.

Total: 15 periods

SEMESTER - II

DEPARTMENT OF MATHEMATICS

Subject Code : BMA18004	Subject Name : BIO STATISTICS	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	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

OBJECTIVES :

- Understand the Basic concepts in Statistics
- Use the Basic concepts in Correlation
- Understand the Basic concepts in Probability theory
- Apply the Basic concepts in Testing of Hypothesis
- 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	3	3				3			2		2	2
CO2	3	3				3			1			3
CO3	3	3	1		1	2			1		1	3
CO4	3	3	1		1	2			2			3
CO5	3	3	3	2					2			3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BMA18004	Subject Name : BIO STATISTICS	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	TY	3	1/0	0/ 0	4

UNIT I - BASICS OF STATISTICS **12 Hrs**

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

UNIT II - CORRELATION **12 Hrs**

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

UNIT III - PROBABILITY AND RANDOM VARIABLE **12 Hrs**

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).

UNIT IV - SAMPLING **12 Hrs**

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

UNIT V - DESIGN OF EXPERIMENTS **12 Hrs**

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 (9^{th}ed), Prentice Hall of India, (2016).*

DEPARTMENT OF PHYSICS

Subject Code : BPH18002	Subject Name : ENGINEERING PHYSICS – II	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	TY	2	0/1	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 :

- Design, conduct experiment and analyze data.
- Develop a Scientific attitude at micro and nano scale of materials
- Understand the concepts of Modern Physics
- 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	PO 12
CO1	3	3	2	2	2	1				2		1
CO2	3	3		2	2							1
CO3	3	3	3	3	2					2		
CO4	3	3	3	3	2				3	2		1
CO5	3	2	2	2	2	1			2	2		1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BPH18002	Subject Name : ENGINEERING PHYSICS – II	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	TY	2	0/1	0/0	3

UNIT I - QUANTUM PHYSICS **9 Hrs**

Quantum free electron theory - deBroglie waves - derivation of deBroglie waves - Davisson and Germer experiment - uncertainty principle - electron microscope - scanning electron microscope - physical significance of wave function - Schrodinger wave equation and its applications - Fermi energy- effective mass - phonons - Fermi function-density of states - origin of bandgap in solids - 1D scattering of electrons in periodic potential.

UNIT II - SEMICONDUCTORS **9 Hrs**

Introduction - properties of semiconductors - classification of semiconductor - effect of temperature in semiconductor - hole current - carrier concentration in intrinsic semiconductor (electron and hole density) - variation of Fermi energy level and carrier concentration with temperature in an intrinsic semiconductor - carrier transport - diffusion - drift - mobility - Hall effect - determination of Hall coefficient and its applications - diodes.

UNIT III - LIGHT SEMICONDUCTOR INTERACTION **9 Hrs**

Types of electronic materials: metals, semiconductors and insulators - qualitative analysis of extrinsic semiconductor & its applications - optical transition in bulk semiconductors: absorption, spontaneous and stimulated emission - exciton and its types - traps and its types - colour centers and its types and importance - luminescence - classifications of luminescence based on excitation - optical loss and gain - Photovoltaic effect - Photovoltaic potential - spectral response - solar energy converters - solar cells.

UNIT IV - OPTO ELECTRONIC DEVICES **9 Hrs**

Photodetectors - photoconductors - photodiodes principle, construction, working and characteristics - Phototransistors - Laser diodes - LED theory, construction and working - seven segment display, advantages of LED - LCD theory, construction and working.

UNIT V - ENGINEERED MATERIALS **9 Hrs**

Classification of engineered materials - nano phase materials - its synthesis and properties - shape memory alloys and its applications - biomaterials - non linear materials - metallic glasses - metamaterials - homo and hetero junction semiconductors - semiconducting materials for optoelectronic devices - quantum wells, wires and dots.

Total no. of Periods : 45

TEXT BOOKS

(1) P.K. Palanisamy, Semiconductor Physics and Optoelectronics, Scitech Publications, 2010
(2) Jyoti Prasad Bandyopadhyay, Semicoductor Devices, S. Chand Publications, 2014
(3) Charles Kittal, Introduction to Solid State Physics, Wiley Publications, 2012

REFERENCE BOOKS

1. *S. Shubhashree, S. Bharathi Devi & S. Chellammal Madhusudanan, Engineering Physics, Sree Lakshmi Publications, 2004*
2. *G. Senthil Kumar, N. Iyandurai, & G. Vijayakumar, Material Science, VRB Publishers, 2017*
3. *R.Murugeshan & Kiruthigasivaprakash, Modern Physics, 14th edition, S. Chand & Co, 2008*
4. *Pallab Bhattacharya, Semiconductor optoelectronic devices, second edition, Pearson Education, 2003*
5. *V Rajendran & A. Marikani, Materials Science, Tata McGraw- Hill, New Delhi, 2004*

DEPARTMENT OF CHEMISTRY

Subject Code : BCH18002	Subject Name :ENGINEERING CHEMISTRY – II	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	**TY**	**2**	**0/1**	**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 :

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

COURSE OUTCOMES (Cos) : (1 – 5)

Students completing the course were able to

CO1	Understand the science of phase equilibria and apply the phase rule to different systems.
CO2	Gain an overview of Engineering Materials such as Lime, Cement, Lubricants, Abrasives, Refractories,Alloys and Nanomaterials.
CO3	Recognize the essential information about consumer products such as Soaps and Detergents,also gaining the basic knowledge about Explosives and Propellants.
CO4	Discover the fuel Chemistry and Combustion process.
CO5	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	PO 9	PO 10	PO11	PO12
CO1	**3**											**1**
CO2	**3**		**3**			**1**	**3**					**1**
CO3	**3**					**3**						**1**
CO4	**3**	**2**	**3**	**3**			**3**					**2**
CO5	**3**				**2**							**3**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BCH18002	Subject Name : ENGINEERING CHEMISTRY – II	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	TY	2	0/1	0/ 0	3

UNIT I - PHASE EQUILIBRIA **8 Hrs**

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.

UNIT II - MATERIAL CHEMISTRY **10 Hrs**

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.

UNIT III - APPLIED CHEMISTRY **9 Hrs**

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.

UNIT IV - FUELS & COMBUSTION **9 Hrs**

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.

UNIT V - ANALYTICAL AND CHARACTERIZATION TECHNIQUES **9 Hrs**

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 : BES18003	Subject Name : ENVIRONMENTAL SCIENCE (Non- Credited)	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	-	-	-		-

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

OBJECTIVES :

- To acquire knowledge of the Environment and Ecosystem & Biodiversity
- To acquire knowledge of the different types of Environmental pollution
- To know more about Natural Resources
- To gain understanding of social issues and the Environment
- 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	PO 11	PO12
CO1						**2**	**3**	**2**				**2**
CO2						**2**	**3**			**2**		**2**
CO3						**2**	**3**	**2**				**2**
CO4						**2**	**3**	**2**		**2**		**2**
CO5						**2**	**3**			**2**		**2**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BES18003	Subject Name : ENVIRONMENTAL SCIENCE (Non- Credited)	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	-	-	-		-

UNIT I - ENVIRONMENT AND ECOSYSTEM

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

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

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

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

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

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.*

Subject Code : BEN18ET1	Subject Name : Communication Lab	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	1	0/0	2/0	1

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

OBJECTIVES :

The Student should able to

- Use appropriate vocabulary and structure for the effective interpersonal and academic communication
- Interpret chart, diagrams and advertisement Etc.
- Participate in group discussion and projects effectively
- Present Project effectively
- Attend interviews

COURSE OUTCOMES (Cos) : (3 – 5)

Students completing the course would be able to

CO1	Use appropriate vocabulary and structure for the effective interpersonal and academic communication
CO2	Interpret chart, diagrams and advertisement Etc.
CO3	Participate in group discussion and projects effectively
CO4	Present Project effectively
CO5	Attend interviews

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**						**3**		**3**
CO2				**3**						**3**		**3**
CO3				**3**		**2**			**3**	**3**		**3**
CO4				**3**					**3**	**3**		**3**
CO5				**3**					**3**	**3**		**3**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BEN18ET1	Subject Name : Communication Lab	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	1	0/0	2/0	1

UNIT I **6 Hrs**

Listening and Speaking- Informal and Formal Contexts

UNIT II **6 Hrs**

Compeering -Anchoring -Group Discussion

UNIT III **6 Hrs**

Poster Presentation -Welcome Speech -Vote of Thanks

UNIT IV **8 Hrs**

Formal Presentation -Power point presentation of charts/ Diagrams

UNIT V **4 Hrs**

Facing an Interview- Mock Interview

SUGGESTED READINGS: **Total hours- 30**

(i) *Practical English Usage.* Michael Swan. OUP. 1995.

(ii) *Remedial English Grammar.* F.T. Wood. Macmillan.2007

(iii)*On Writing Well.* William Zinsser. Harper Resource Book. 2001

(iv) *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

(v) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

(vi) *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press

(vi) Pronunciation in Use ,Mark Hancock. Cambridge University Press. 2012

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DEPARTMENT OF MECHANICAL ENGINEERING

SubjectCode: BES18ET2	Subject Name : BASIC ENGINEERING GRAPHICS	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	1	0/0	2/0	2

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

OBJECTIVES :

- Learn to know what kind of pencils to be used to sketch lines, numbers, Letters and Dimensioning in drawing sheet.
- Draw Projection of points, line, planes and solids using Drafters
- To identify the angle of projection and development of surfaces, isometric projection and Orthographic projection
- Know the basics of elevation and plan of building.
- 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	3	3	3	2	2	2			3	3		3
CO2	3	3	3	2	2	2			3	3		3
CO3	3	3	3	1		2			2	2		2
CO4	3	3	2	2		3		2	3	3		3
CO5	3	3	3	2	3	1		2	3	3		3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

SubjectCode: BES18ET2	Subject Name : BASIC ENGINEERING GRAPHICS	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	1	0/0	2/0	2

CONCEPTS AND CONVENTIONS (Not for examination)

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 Hrs

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 Hrs

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 Hrs

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 Hrs

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 6 Hrs

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, Bangalo

Subject Code : BES18L02	**Subject Name : INTEGRATED PHYSICAL SCIENCE LAB**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**ETL**	**0**	**0/0**	**2/0**	**1**

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

OBJECTIVES :

- Demonstrate the ability to make physical measurements & understand the limits of precision in measurements.
- Display the ability to measure properties of variety of electrical, mechanical, optical systems.
- To help learners measure conductivity and EMF using electrical equipment.
- To understand the analytical skills through chromatography & viscometry
- To familiarize the concepts of cheminformatics

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 mechanical, optical, electrical and electronic systems.
CO3	Familiarizing the titration methods using conductometry & potentiometry
CO4	Developing the Research spirit through the knowledge of Cheminformatics & Analytical skills.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO1 1**	**PO12**
CO1	**3**	**3**	**1**	**3**	**3**							
CO2	**3**	**3**	**2**	**3**	**3**					**2**		
CO3	**3**	**3**	**2**	**3**	**3**				**3**			
CO4	**3**	**3**	**3**	**3**	**3**				**3**		**3**	**2**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BES18L02	**Subject Name : INTEGRATED PHYSICAL SCIENCE LAB**	**TY / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite : None	**ETL**	**0**	**0/0**	**2/0**	**1**

LIST OF EXPERIMENTS

1. Determination of Coefficient of Viscosity of a given liquid by Poiseuille`s method.
2. Particle Size determination using Laser Source.
3. Determination of Numerical Aperture of an Optical Fiber.
4. Spectrometer- Refractive Index/Dispersive power/i-d curve.
5. Potentiometer - Resistance of a wire.
6. Transistor Characteristics - Input Resistance, Output Resistance and Gain .
7. Studies on acid-base conductometric titration.
8. Determination of redox potentials using potentiometry.
9. Determination of R_f values of various components using thin layer chromatography.
10. Viscosity studies using Digital capillary viscometer.
11. Compute the structures of the given polymers, drugs, biomolecules usingChem Draw.
12. Studies on potential energy surface of the given molecules.
13. Estimate NMR spectra from a Chem Draw structure.

DEPARTMENT OF COMPUTER SCIENCE

Subject Code : BES18ET3	Subject Name : C PROGRAMMING AND LAB	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	ETL	1	0/0	2/0	2

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

OBJECTIVES :

- Outline the basics of C Language.
- Apply fundamentals in C programming.
- 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	3	3			2	2		3	2			3
CO2	3	2			3	2		2	3			2
CO3	3			3		2		2	3			2
CO4	3			2		2		3	2			2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code : BES18ET3	Subject Name : C PROGRAMMING AND LAB	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite : None	**ETL**	**1**	**0/0**	**2/0**	**2**

UNIT I - INTRODUCTION **6 Hrs**

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

UNIT II - EXPRESSION AND STATEMENT **6 Hrs**

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

UNIT III - ARRAYS AND FUNCTIONS **6 Hrs**

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.

UNIT IV - STRUCTURES AND POINTERS **6 Hrs**

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

UNIT V - STRINGS AND FILE HANDLING **6 Hrs**

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

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.

SEMESTER - III

Subject Code: BBT18001	Subject Name : BIOCHEMISTRY	TY / L/ ETL	L	T / S.Lr	P/ R	C
	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 concepts of fundamentals of biochemical processes and biomolecules.
CO2	Relate the major pathways of the biomolecules relevant to clinical conditions.
CO3	Illustrate the biochemical process of biological oxidation.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	3	-	-	-	-	-	-	-	-
CO2	-	2	-	3	-	-	-	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	-	2
CO2	-	2	2
CO3	-	-	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18001	Subject Name : BIOCHEMISTRY	TY / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	Ty	3	1/0	0/0	4

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

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

UNIT II - BIOLOGICAL OXIDATION **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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

Total number of periods: 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.*

Subject Code: BBT18002	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	Acquire the basic knowledge of bacterial cell structure, Classification systems, Staining methods, the nutritional requirements of bacteria and get equipped with various methods of bacterial growth measurement.
CO2	Describe fungi and virus classification, structure, types and replication cycles.
CO3	Understand the Principles of sterilization and disinfection, various physical andchemical means of sterilization and evaluation of disinfectants. Analyze the antibiotic mode of action and microbial resistance towards antibiotics.

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	-	2	2	2	3	-	2	2	-	-	-	-
CO2	-	2	2	2	3	-	2	2	-	-	-	-
CO3	-	2	2	2	3	-	2	2	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	-	2
CO2	-	-	2
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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:	Subject Name : MICROBIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18002	Prerequisite: Nil	TY	3	1/0	0/0	4

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

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 number of periods: 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*

Subject Code: BBT18003	Subject Name : ENZYME TECHNOLOGY	T / L/ ETL	L	T / S. Lr	P/ R	C
	Prerequisite: Nil	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 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	To understand and access the regulations and kinetics of enzyme.
CO2	Apply the knowledge about in the purification and characterization from natural sources
CO3	Ability to construct biosensors by understanding the concept of enzyme immobilization.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	-	2	-
CO2	3	-	-
CO3	3	2	-

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18003	Subject Name : ENZYME TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT I - INTRODUCTION TO ENZYMES **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 number of periods: 45

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.

Subject Code:	Subject Name :THERMODYNAMICS AND STOICHIOMETRY	T / L/ ETL	L	T / S.Lr	P/R	C
BBT18004	Prerequisite: Physics / Chemistry	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 of classical and statistical thermodynamics.

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

CO1	Identify the basic concepts of thermodynamics and its applications.
CO2	Execute the thermodynamic principles in the bio chemical process
CO3	Examine the dimensionless groups and enthalpy calculations for various unit operations.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	3
CO3	3	2	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code: BBT18004	Subject Name:THERMODYNAMICS AND STOICHIOMETRY	T / L/ ETL	L	T / S.Lr	P/R	C
	Prerequisite: C Programming	TY	3	0/0	0/0	3

UNIT I - BASIC CONCEPTS OFTHERMODYNAMICS 9 Hrs

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.

UNIT II - THERMODYNAMICS AND ITS APPLICATIONS 9 Hrs

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.

UNIT III - BIOCHEMICAL THERMODYNAMICS 9 Hrs

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.

UNIT IV - SMALL UNITS AND DIMENSIONS 9 Hrs

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 number of periods: 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*

Subject Code:	Subject Name :Object oriented Programming for Biotechnologists	T / L/ ETL	L	T / S.Lr	P/R	C
BCS18I04	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	To give an insight about the basic concepts of OOPS
CO2	Evaluate the features of OOPS with procedural Oriented concepts and analyze these features to a real world object
CO3	Develop program that support Various data types at runtime and ability to handle exceptions

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	2	3	-	-	-	-	-	-	-
CO2	-	-	-	2	3	-	-	-	-	-	-	-
CO3	-	-	-	2	3	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3				
CO1	3	3	3				
CO2	3	3	3				
CO3	3	3	3				

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code: BCS18I04	Subject Name :Object oriented Programming for Biotechnologists	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: C Programming	Ty	3	0/0	0/0	3

UNIT I - INTRODUCTION **9 Hrs**

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 **9 Hrs**

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 number of periods: 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)*

PRACTICALS

SEMESTER III

Subject Code:	Subject Name :BIOCHEMISTRY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18 L01	Prerequisite: Chemistry	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 learn and understand the principles behind the qualitative and quantitative estimation of biomolecules

COURSE OUTCOMES (COs) : Students will acquire knowledge about

CO1	The students will learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system.
CO2	The students will understand about the structure and function of nucleosides and nucleotides and accessory molecules like vitamins, plant and animal harmones, plant secondary metabolite like terpenes.
CO3	The students will learn about structure and function of lipids, circulating lipids and inflammatory lipid mediators etc.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO 11	PO12
CO1	-	-	2	2	-	-	-	-	2	1	-	-
CO2	-	-	2	2	-	-	-	-	2	1	-	-
CO2	-	-	2	2	-	-	-	-	2	1	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	2	1	2
CO2	1	1	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L01	Subject Name :BIOCHEMISTRY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Chemistry	Lb	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: BBT18L02	Subject Name :MICROBIOLOGY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	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 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	Handle the basic instruments – Autoclave, laminar air flow, incubator, pH meter, colorimeter used for the microbial cultivation.
CO2	Understand the working principle and operation of compound microscope with deep knowledge on the sample preparation and staining techniques.
CO3	Acquire the practical knowledge of various biochemical phenomena of different types of microbes, their applications and interpretation 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	-	-	1	2	-	3	3	-	-	1	-	-
CO2	-	-	1	2	-	3	3	-	-	1	-	-
CO3	-	-	2	2	-	3	3	-	-	1	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	-	2	2
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L02	Subject Name :MICROBIOLOGY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	Lb	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: BCS18IL4	Subject Name : OBJECT ORIENTED PROGRAMMING LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	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 enable the students to learn about basic concepts in programming for biotechnologists

COURSE OUTCOMES (COs) :

CO1	Explore the basic concepts of oops
CO2	Apply the OOPS features in Procedural Oriented Programming
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	-	-	-	2	3	-	-	-	-	1	-	-
CO2	-	-	-	2	3	-	-	-	-	1	-	-
CO3	-	-	-	2	3	-	-	-	-	1	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BCS18IL4	Subject Name : OBJECT ORIENTED PROGRAMMING LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	Lb	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*

SEMESTER – IV

Subject Code: BMA18015	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 and matrices
CO2	Understand the sequences and series
CO3	Understand the sequences ordinary differential equation and 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	3	3	3	2	-	-	-	-	-	-	-	1
CO2	3	3	3	2	-	-	-	-	-	-	-	1
CO3	3	3	3	2	-	-	-	-	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	-	-
CO2	2	-	-
CO3	2	-	-

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BMA18015	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 number of periods: 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: BBT18005	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

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	To remember the working principle and understand the theoretical knowledge about instruments
CO2	To practice the handling of instruments and its applications
CO3	To develop skills among students about instrumentation and biological techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	2	-	-	-	-	-	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-	-
CO3	3	2	-	2	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	2	3
CO3	3	2	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18005	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 number of periods: 60

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)*

Subject Code: BBT18006	Subject Name : MICROBIAL BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology	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 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	Acquire the basic knowledge of bacterial cell structure, Classification systems, Staining methods, the nutritional requirements of bacteria and get equipped with various methods of bacterial growth measurement.
CO2	Describe fungi and virus classification, structure, types and replication cycles.
CO3	Understand the Principles of sterilization and disinfection, various physical and chemical means of sterilization and evaluation of disinfectants. Analyze the antibiotic mode of action and microbial resistance towards antibiotics.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	2	3	-	2	2	-	-	-	-
CO2	-	2	2	2	3	-	2	2	-	-	-	-
CO3	-	2	2	2	3	-	2	2	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	-	2	2
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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:	Subject Name : MICROBIAL BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18006	Prerequisite: Microbiology	Ty	3	0/0	0/0	3

UNIT I - HISTORY AND SCOPE **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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.

UNIT IV - MICROBES IN BIOREMEDIATION AND IN GENERATION OF ENERGY **9 Hrs**

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 **9 Hrs**

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 number of periods: 45

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: BCS18I05	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	Explore how to utilize a relational database to store data in an electronic way.
CO2	Probably learn how to use SQL to retrieve the data stored in the database.
CO3	Implement the transaction concepts to 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	-	-	-	2	3	-	-	-	-	-	-	-
CO2	-	-	-	2	3	-	-	-	-	-	-	-
CO3	-	-	-	2	3	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BCS18I05	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

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

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

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

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 **9 Hrs**

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

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

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 **9 Hrs**

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 number of periods: 45

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: BHS18NC1	Subject Name : The Indian Constitution	T / L/ ET	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	Ty	2	0/0	0/ 0	NC

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

OBJECTIVES:

- To provide an overview of the history of the making of Indian Constitution
- To understand the preamble and the basic structures of the Constitution.
- To Know the fundamental rights, duties and the directive principles of state policy
- To understand the functionality of the legislature , the executive and the judiciary

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	To provide an overview of the history of the making of Indian Constitution
CO2	To understand the preamble and the basic structures of the Constitution.
CO3	To Know the fundamental rights, duties and the directive principles of state policy

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	1	1	1	1	-	-
CO2	-	-	-	-	-	3	1	1	1	1	-	-
CO2	-	-	-	-	-	3	1	1	2	1	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	1	2
CO3	1	1	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

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

Subject Code: BHS18NC1	Subject Name : The Indian Constitution	T / L/ ETL	L	T / S. Lr	P/ R	C
	Prerequisite: NIL	Ty	2	0/0	0/ 0	NC

UNIT 1 **3Hrs**

The History of the Making of Indian Constitution, Preamble and the Basic Structures

UNIT 2 **3Hrs**

Fundamental Rights and Duties , Directive Principles of State Policy

UNIT 3 **3Hrs**

Legislature, Executive and Judiciary

UNIT 4 **3Hrs**

Emergency Powers

UNIT 5 **3Hrs**

Special Provisions for Jammu and Kashmir, Nagaland and Other Regions, Amendments

Total no Hrs: 15 Hrs

TEXT BOOKS:

1. D D Basu, Introduction to the Constitution of India, 20th Edn.,LexisnexisButterworths, 2012.

REFERENCE BOOKS:

1. *Rajeev Bhargava (ed), Ethics and Politics of the Indian Constitution, Oxford University Press, New Delhi, 2008.*
2. *Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press, Oxford, 1966.*
3. *Zoya Hassan, E. Sridharan and R. Sudarshan (eds), India's Living Constitution: Ideas, Practices, Controversies, Permanent Black, New Delhi, 2002.*
4. *Subhash C. Kashyap, Our Constitution, National Book Trust, New Delhi, 2011.*

Subject Code: BHS18NC2	Subject Name : The Indian traditional knowledge	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

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 Pre- colonial and Colonial Period, Indian Traditional Knowledge System
- To understand the Traditional Medicine, Traditional Production and Construction Technology
- To Know the History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology
- To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	To understand the Pre- colonial and Colonial Period, Indian Traditional Knowledge System
CO2	To understand the Traditional Medicine, Traditional Production and Construction Technology
CO3	To understand the Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	3	1		2	-	-	-	2	-	1
CO2	-	3	3	1		2	-	-	-	2	-	1
CO2	-	3	3	1		2	-	-	-	2	-	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	1	1	2
CO3	1	1	2

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			
			✓									

Subject Code: BHS18NC2	Subject Name : The Indian traditional knowledge	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	Ty	2	0/0	0/0	NC

UNIT I **3 Hrs**

Historical Background: TKS During the Pre- colonial and Colonial Period, Indian Traditional Knowledge System

UNIT II **3 Hrs**

Traditional Medicine, Traditional Production and Construction Technology

UNIT III **3 Hrs**

History of Physics and Chemistry, Traditional Art and Architecture and Vastu Shashtra, Astronomy and Astrology

UNIT IV **3 Hrs**

Origin of Mathematics, Aviation Technology in Ancient India, Crafts and Trade in Ancient India

UNIT V **3 Hrs**

TKS and the Contemporary World, TKS and the Indian Union, TKS and IT Revolution

Total no Hrs: 15 Hrs

TEXT BOOKS:

1. Amit Jha (2009) , Traditional knowledge system in india, 1st Edition, Delhi University (North Campus)
2. Dr.A.K.Ghosh (2011), Traditional Knowledge of Household Products

PRACTICALS

SEMESTER - IV

Subject Code: BHS20ET5	Subject Name :UNIVERSAL HUMAN VALUES 2 : UNDERSTANDING HARMONY	TY / LB/ ETL/IE	L	T / S.Lr	P/R	C
	Prerequisite: NIL	ETL	1	0/1	3/0	3

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

OBJECTIVE :Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.

Development of commitment and courage to act

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

CO1	Relate self and surroundings and identify responsibility in life
CO2	Associate human relationship and nature to handle problems and provide sustainable solutions
CO3	Develop critical ability and engage in reflective and independent Thinking

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1	1		2	2		1	1		2
CO2			2	2	2	2	3	1		2		2
CO3			1	1	2	2			1	2		3

COs /PSOs	PSO1	PSO2	PSO3
CO1	1	1	3
CO2	1	1	3
CO3	1	1	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-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: BHS20ET5	Subject Name :UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	TY / LB/ ETL/IE	L	T / S.Lr	P/R	C
	Prerequisite: NIL	ETL	1	0/1	3/0	3

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education 9 Hrs

Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration–what is it? - Its content and process;' Natural Acceptance' and Experiential Validation-as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic Requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II Understanding Harmony in the Human Being - Harmony in Myself! 9 Hrs

Understanding human being as a co-existence of the sentient 'I' and the material'Body'.- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT III Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship 9 Hrs

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship - Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV Understanding Harmony in the Nature and Existence - Whole existence as Coexistence 9 Hrs

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as Co-existence of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence - Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V Implications of the above Holistic Understanding of Harmony on professional Ethics 9 Hrs

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. - Case studies of Typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order: ((a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, (b)At the level of society: as mutually enriching institutions and organizations - Sum up Include practice Exercises and Case Studies will be taken up in Practice (tutorial)
Sessions e.g. to discuss the conduct as an engineer or scientist etc.

Text Book

- Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010

Reference Books

- Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
- Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
- The Story of Stuff (Book).
- The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
- Small is Beautiful - E. F Schumacher.
- Slow is Beautiful - Cecile Andrews
- Economy of Permanence - J C Kumarappa
- Bharat Mein Angreji Raj - PanditSunderlal
- Rediscovering India - by Dharampal
- Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
- India Wins Freedom - Maulana Abdul Kalam Azad
- Vivekananda - Romain Rolland (English)
- Gandhi - Romain Rolland (English)

Subject Code: BBT18L03	Subject Name : INSTRUMENTAL METHODS OF ANALYSIS LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry 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 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 understand practical knowledge about various instruments
CO2	To acquire experience in the purification by performing chromatographic technique
CO3	To analyse several biomolecule using spectrophotometer and colorimeter

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	-	-	-	3	2	-	-	-	-	-	-	-
CO2	-	-	-	3	2	-	-	-	-	-	-	-
CO3	-	-	-	3	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L03	Subject Name :INSTRUMENTAL METHODS OF ANALYSIS LAB	T / L/ ETL	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: BBT18L04	Subject Name :MICROBIAL BIOTECHNOLOGY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology 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 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	Understand about microbial biodiversity and its uses, familiarize on mass cultivation and preservation of micro-organisms.
CO2	Explore and analyze the different types of microbial metabolites production on industrial scale.
CO3	Evaluate the importance of microbes in industrial, agricultural and environmental sectors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	2	3	-	2	2	-	-	-	-
CO2	-	2	2	2	3	-	2	2	-	-	-	-
CO3	-	2	2	2	3	-	2	2	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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:	Subject Name :MICROBIAL BIOTECHNOLOGY LAB	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18L04	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: BCS18IL5	Subject Name :BIO DATABASE SYSTEMS LAB	T / L/ 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	To understand the concept of Data retrieval from a Database with help of SQL
CO2	Storing of data in a electronic format by making use of Relational database
CO3	Apply the transaction concepts to 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	-	-	-	2	3	-	-	-	-	1	-	-
CO2	-	-	-	2	3	-	-	-	-	1	-	-
CO3	-	-	-	2	3	-	-	-	-	1	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BCS18IL5	Subject Name : BIO DATABASE SYSTEMS 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: BBT18TS1	Subject Name :TECHNICAL SKILLS I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	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 : 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	To get knowledge about the biotechnology skill through value added courses
CO2	Ability to understand the biotechnological contemporary issues
CO3	To enrich the thinking of students towards biotechnological problem solving skill

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	1	-	-	-	-	-	1	2	-	-
CO2	-	2	1	-	-	-	-	-	1	2	-	-
CO3	-	2	1	-	-	-	-	-	1	2	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	1	2
CO3	2	1	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18TS1	Subject Name :TECHNICAL SKILLS I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Lb	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

Subject Code: BEN18SK1	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	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 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	Develop the skills to get employed and have a self esteem and a sense of self worth to be a good team member
CO2	Develop empathy to think from other's point of view and evolve as global citizens with insights into social and professional ethics
CO3	Develop lifelong learning skills to adapt in the multicultural context of workplaces.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	-

COs / PSOs	PSO1	PSO2	PSO3				
CO1	2	2	3				
CO2	2	2	3				
CO3	2	2	3				

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BEN18SK1	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	1

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

SEMESTER - V

Subject Code: BBT18008	Subject Name :Molecular Biology and Recombinant DNA technology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & 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 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	Discuss on the basic concepts and principles of nucleic acids from the perspective of engineers
CO2	Illustrate the mechanism and role of the nucleic acids in, replication, gene expression and gene regulation in prokaryotic and eukaryotic organisms .
CO3	Applying molecular biology knowledge in to Recombinant technology , DNA sequences and polymerase chain reactions

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	1	3	2	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	-	-	-	-	-	-	-	-
CO3	1	3	2	-	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	**1**	**2**	**2**
CO2	**2**	**1**	**1**
CO3	**2**	**1**	**2**

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18008	Subject Name :Molecular Biology and Recombinant DNA technology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	Ty	3	1/0	0/0	4

UNIT I - STRUCTURE, REPLICATION AND REPAIR MECHANISM **12 Hrs**

DNA Structure, RNA structure, Replication process of prokaryotic and eukaryotic, Replication errors-Mutagens-their repair mechanism. Recombination mechanism in prokaryotea nd eukaryotes, transposition- transposase – replicative transposition, non-replicative transposition.

UNIT II - TRANSCRIPTION AND TRANSLATION **12 Hrs**

Types of RNA polymerases, prokaryotic and eukaryotic transcription- splicing and editing, mRNAtransport, inhibitors of transcription, Role of mRNA and tRNA in translation process, structure of ribosome, mechanism of Prokaryotic and Eukaryotic translation process, Wobble hypothesis, Deviations from the universal genetic code

UNIT III - GENE REGULATION **12 Hrs**

Prokaryotes – activators and repressors, DNA looping, 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

UNIT IV - ENZYMES IN RECOMBINANT TECHNOLOGY AND CLONING VECTORS **12 Hrs**

Restriction Endonucleases,DNA manipulating enzymes, conversion of blunt end to Cohesive end, Hybridization techniques: Southern, Northern and colony hybridization, Plasmid Vectors : PBR 322, PUC19 vectors, Bacteriophage vectors : Insertion and replacement vectors, Cosmids, M13 Vectors,. Expression vectors, yeast vectors, artificial chromosome vectors: YAC and BAC, Methods for introducing DNA into cells, apllication of recombinant DNA technology (Insulin,vaccines)

UNIT V - CONSTRUCTION OF LIBRARIES AND DNA SEQUENCING **12 Hrs**

Construction of Genomic and cDNA Libraries, Screening of libraries - gene probes, with antibodies. labeling of DNA probes: Nick translation, Random priming, Radioactive and non-radioactive probes, Principles of DNA Sequencing and its types, PCR, Types of PCR:Real time PCR, Reverse transcriptase PCR, nested PCR, Applications of PCR

Total Number of 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. *Bernard R. Glick, Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press (2010)*

Subject Code: BEI18I03	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	Remember the introduction to process control, mathematical modelling of simple processes, batch and continuous process, controllers, gas analyzers, closed loop systems, instrumentation and bio-sensors
CO2	Understand and apply the concepts in process control, mathematical modelling of simple processes, batch and continuous process, controllers, gas analyzers, closed loop systems, instrumentation and bio-sensors
CO3	Analyze and evaluate the concepts in process control, mathematical modelling of simple processes, batch and continuous process, controllers, gas analyzers, closed loop systems, instrumentation and bio-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	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	2	3
CO3	2	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BEI18I03	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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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

Total Number of 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: BBT18009	Subject Name :IMMUNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	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 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	Describe the immune system and their structure and classification
CO2	Explain various methods to access immune function , their function and interpretation of the results
CO3	Describe how immune cells, organs and processes function to protect human body against infective agents and cancer cells

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	3	2	1	-	-	-	-	-	-
CO2	-	-	2	3	2	1	-	-	-	-	-	-
CO3	-	-	2	3	2	1	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	1	1	1
CO3	1	1	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18009	Subject Name :Immunology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbiology	Ty	3	0/0	0/0	3

UNIT I - INTRODUCTION **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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.

UNIT IV - TRANSPLANTATION AND TUMORIMMUNOLOGY **9 Hrs**

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 **9 Hrs**

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

Total Number of Hours: 45

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*

PRACTICALS
SEMESTER - V

Subject Code: BBT20ET6	Subject Name : CELL BIOLOGY & GENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	ETL	1	0/1	3/0	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 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	Understand and identify the structure and function of cell and its organelle.
CO2	Understand and compare the molecular mechanism involved in signal transduction.
CO3	Ability to understand concepts of inheritance of structure and disease associated with chromosome

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	2	-	-	-	-	-	-	-	-
CO2	-	2	2	2	-	-	-	-	-	-	-	-
CO3	-	2	2	2	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3				
CO1	3	3	3				
CO2	3	3	3				
CO3	3	3	3				

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT20ET6	Subject Name : CELL BIOLOGY & GENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Nil	ETL	1	0/1	3/0	3

UNIT I: CELLS AND ORGANELLES **9 Hrs**

Cells and organelles, Functions of membranes, models of membrane architecture, transport across membranes – simple diffusion, facilitated diffusion through carrier proteins and channel proteins, active transport, energetics of transport, Cell division in prokaryotes and eukaryotes (mitosis and meiosis), Cell cycle, and cell cycle regulation.

UNIT II: ENDOMEMBRANE SYSTEMS AND PEROXISOMES **9 Hrs**

Structure of ER and glogi complex; Role of ER and golgi complex in protein glycosylation, secretary pathwa4ys, protein trafficking, exocytosis, endocytosis, coated vesicles in cellular transport processes; Lysosomes and cellular digestion. Role of plant vacuole and peroxisomes.

UNITIII: SIGNALTRANSDUCTION 9 **Hrs**

Signal transduction through messengers and receptors. Chemical signals and cellular receptors; G- Protein linked receptors, protein kinase associated receptors, hormonal signaling

UNIT IV: MENDELIAN LAWS OF INHERITANCE **9 Hrs**

Mendelian laws of inheritance, composition of chromatin, Prokaryotic and Eukaryotic genome organization, Different types of chromosomes (polytene and lamp brush chromosome, giant chromosomes), sex determination in animals. Non-disjunction of X chromosomes, linkage and crossing over.

UNIT V: GENETIC DISORDERS **9Hrs**

Genetic disorders: Autosomal dominant disorders, sex linked inheritance, Multiple alleles ABO blood groups, Rh incompatibity,Principles of Hardy Weinberg law-Gene frequency, genotype frequency.

Total no of periods = 60

References/ Text books

- Cell Biology, De Roberties & De Roberties, Blaze publishers & Distributors Pvt. Ltd., New Delhi, 2001.
- Molecular cell Biology (III rd Edition), Harvey Lodish, David Baltimore et al., W.H. Freeman, 2000.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, 2007. Molecular Biology of the Cell, Fifth edition. Garland Science.
- Hartl L D and Jones B, Analysis of genes and genomes, 3rd Edition, Jones and Bartlett Publishers, 1994.
- Principles of Genetics. 8th edition by Gardner, Simmons and Snustad. 2002.

Subject Code: BBT18L05	Subject Name : Immunology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology 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 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	Recognise the morphology and functions of various immune cells corresponding to their immunological response
CO2	Use experimental techniques to address changes in immunological reactions in immune system
CO3	Develop an ability to summarize , integrate and organize information and relate it to disease outcomes

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	3	2	1	-	-	-	-	-	-
CO2	-	-	2	3	2	1	-	-	-	-	-	-
CO3	-	-	3	3	2	1	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	1	2	2
CO3	2	2	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L05	Subject Name : Immunology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology Lab	Lb	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: BBT18L06	Subject Name : Molecular Biology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology 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 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	To understand the basic molecular techniques such as Plasmid isolation, Transformation techniques
CO2	To apply molecular techniques for students to attain knowledge in nucleic acids , hybridization and enzyme digestion
CO2	To analyze the outcomes of various molecular biology techniques based on nucleic acid restriction , digestion and hybridization

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	-	-	-	-	-	-	-	-	-
CO2	1	3	2	-	-	-	-	-	-	-	-	-
CO3	1	3	2	-	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	2	1	1
CO3	2	1	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L06	Subject Name :Molecular Biology Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry Lab & Microbiology Lab	Lb	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: BEI18IL3	Subject Name : Bioprocess Control Systems Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	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 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	Remember and recall the introduction to various types of controllers for temperature process pressure process and level process
CO2	Understand and apply the concepts for various types of controllers for temperature process pressure process and level process
CO3	Analyze and evaluate and experiment the concepts in controllers for temperature process pressure process and level process

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	2	2
CO3	3	2	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BEI18IL3	Subject Name : Bio Process Control systems Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Physics	Lb	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: BBT18TS2	Subject Name :TECHNICAL SKILLS - II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	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 :

- 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	To get knowledge about the biotechnology skill through value added courses
CO2	Ability to understand the biotechnological contemporary issues
CO3	To enrich the thinking of students towards biotechnological problem solving skill

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	-	-	-	-	1	2	-	-
CO2	-	2	2	-	-	-	-	-	1	2	-	-
CO3	-	2	2	-	-	-	-	-	1	2	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18TS2	Subject Name :TECHNICAL SKILLS - II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Lb	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

SEMESTER - VI

Subject Code: BBT18010	Subject Name :Bioprocess Engineering	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology/Chemical Reaction Engineering/Enzyme technology	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 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	Classify the various industrial fermentation process and types of bioreactors.
CO2	Demonstrate the medium requirement, formulation and optimization for fermentation and sterilization kinetics.
CO3	Examine the gas-liquid mass transfer coefficients and the industrial applications of bio process engineering

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	1	2	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18010	Subject Name :Bioprocess Engineering	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology/Chemical Reaction Engineering/Enzyme technology	Ty	3	1/0	0/0	4

UNIT I - OVERVIEW OF BIOPROCESS ENGINEERING **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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

Subject Code: BBT18011	Subject Name :Bioinformatics	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Protein Science /Molecular Biology	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 learn nucleotide, protein and genome databases and know about the file formats. To understand pair wise 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	Understand the basic concepts, methods and tools used in bioinformatics
CO2	Understand the structure function relationship and database queries.
CO3	Ability to apply application of bioinformatics and biological data bases to solve problem in real research.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	3	-	-	-	-	-	-	-
CO2	-	2	-	-	3	-	-	-	-	-	-	-
CO3	-	2	-	-	3	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18011	Subject Name :Bioinformatics	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Protein Science /Molecular Biology	T	3	1/0	0/0	4

UNIT I - BIOLOGICAL DATABASES AND DATA RETRIEVAL **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 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 Number of Hours: 60

TEXT BOOKS

1. *A. Lesk (2002) Introduction to Bioinformatics (3rd Ed), Oxford University Press*
2. *Bioinformatics: An Introduction By 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.

PRACTICALS
SEMESTER -VI

Subject Code: BBT18ET3	Subject Name : PLANT BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular biology & Biochemistry	ETL	1	0/1	3/0	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 organelle DNA in plants and its importance. To understand the principle of nitrogen fixation in plants and genes involved. To understand the role of Agrobacterium and its pathogenesis in crown gall formation. To enlighten the knowledge about Ti plasmid and gene transfer mechanisms; different types of plant viral vectors used in genetic engineering

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

CO1	To understand the genome organization in plants and its regulation.
CO2	To apply the different methods for the development of transgenic plant/crop improvement.
CO3	To illustrate the mechanism and role of plant tissue cultuire for mass multiplications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	3	3	3	-	-	-	-	-	-	-
CO2	-	3	3	3	3	-	-	-	-	-	-	-
CO3	-	3	3	3	3	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	1	1	1
CO3	2	2	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18ET3	Subject Name : PLANT BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular biology & Biochemistry	ETL	1	0/1	3/0	3

UNIT I - PLANT GENOME **9 Hrs**

Plant Genome : Gene structure, expression, and regulation in plants - an overview of nuclear and organelle gene structure, function, and expression, with emphasis on aspects that are unique to plant genes. Development of *Arabidopsis* as a model for molecular genetic studies in plant biology, an introduction to systems approaches.

UNIT II - GENETIC TRANSFORMATION **9 Hrs**

Genetic Transformation : Direct gene Transfer Techniques, Agrobacterium mediated gene transfer- Biology and molecular basis of Agrobacterium mediated plant transformation and its application, Plant vectors, Ri and Ti Plasmids, Opines and their significance. Viral vectors : Gemini virus, cauliflower mosaic virus and their uses. Reverse Genetics.

UNIT III - PLANT DISEASE RESISTANCE **9 Hrs**

Plant Disease Resistance : Types of pathogen and their mode of action, Plant defence system, Constitutive and inducible defence, Genetic basis of plant pathogen interaction, R genes and R gene mediated resistance, Biochemistry and Molecular biology of defence reactions, Systemic acquired resistance, Role of Salicylic, Jasmonic acid and ethylene in plant defence. Plant Stress Response : Abiotic and biotic stress, Pathogen stress, Osmotic adjustment and its role in drought and salinity tolerance, ABA in stress tolerance, Strategies for genetic engineering of stress tolerance

UNIT IV - USE OF KNOCKOUT MUTANT PLANTS **9 Hrs**

Use of knockout mutant plants in understanding the significance of plant hormones, genetically modified plants - Golden rice, vitamin E enhancement, Bt. Cotton, pesticide resistance, cytoplasmic male sterility.Plant genetic resources, Crop gene bank, Plant breeders right and farmers right, patenting of biological materials.

UNIT V - PLANT TISSUE CULTURE **9 Hrs**

Plant tissue culture : Plasticity and Totipotency, The culture environment, Plant Cell culture media, Plant growth regulators and function, Culture types- Callus, Cell-suspension culture, Protoplast culture, Root culture, Shoot tip and Meristem culture, Embryo culture, Microspore culture, Somaclonal variation, Somatic Embryogenesis, Polyploidy, Androgenesis, Artificial Seed, Germplasm Conservation and Cryopreservation.

Total no of Hours: 45

TEXT BOOKS

1. Westhoff et al.(1998). Molecular Plant Development: From gene to plant. Oxford University Press, Oxford. Selected parts available for purchase at the UBC Bookstore.

REFERENCE BOOK

1. Buchanan et al.(2000). Biochemistry & Molecular Biology of Plants. American Society of Plant Physiologists, Rockville MD

2. Heldt HW. (1997) Plant Biochemisty and Molecular Biology. Oxford University Press.

Subject Code: BEN18SK2	Subject Name : Soft Skill-II (QUANTITATIVE APTITUDE)	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Soft skill I	ETL	1	0/1	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 :

- 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	Understand basic concepts of logical statements and logical conclusions
CO2	Understand basic concepts in number system and permutations and combinations
CO3	Analyzing data using pictorial representation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	-	1
CO2	1	-	1
CO3	1	-	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BEN18SK2	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	1

OJECTIVES

1. To bring behavioral patterns of students
2. To train them for corporate culture
3. To create self awareness
4. To build confidence
5. To train the students for facing the interviews and develop interpersonal relationships

UNIT I - Logical Reasoning I **6hrs**

Logical Statements- Arguments- Assumption – Course of Action.

UNIT II - Logical Reasoning II **6hrs**

Logical conclusions-Deriving conclusions from passage- Theme detection.

UNIT III - Arithmetic Reasoning I **6hrs**

Number system-b H.C.F & L.C.M- Problem on ages- Percentage- Profit & Loss- Ratio & Proportion-Partnership.

UNIT IV - Arithmetic Reasoning II **6hrs**

Time & Work- Time & Distance – Clocks – Permutation & Combinations – Heights & Distances – Odd man out and series.

UNIT-V - Data Interpretation **6hrs**

Tabulation – Bar graphs – Pie graphs – Line graphs.

Total Hrs: 30

REFERENCE BOOK:

1. R.S Agarwal A modern approach to Logical Reasoning, S.Chand & Co., (2017).

2. R.S Agarwal A modern approach to Verbal and Non Verbal Reasoning,S.Chand&Co.,(2017).

3. R.S Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand&Co.,(2017).

4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).

Subject Code: BBT18L07	Subject Name : Bioprocess Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology 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 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	Understand the thermal death kinetics and residence time distribution of cells.
CO2	Execute the various techniques for fermentation and immobilization process.
CO3	Evaluate the design of sterilization process and cell size determination by various methods.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	2
CO3	3	3	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L07	Subject Name : Bioprocess Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbial Technology Lab	Lb	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: BBT18L08	Subject Name : Bioinformatics Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology & Protein Science	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 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	Demonstrate the retrieval of sequence data
CO2	Perform experiments related to locating chromosome and gene expression data.
CO3	Demonstrate the data retrieval system of PubMed. Perform the ORF finding and retrieval of gene information computational tools for expression analysis.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	3	-	-	-	-	-	-	-
CO2	-	2	-	-	3	-	-	-	-	-	-	-
CO3	-	2	-	-	3	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L08	Subject Name : Bioinformatics Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Molecular Biology & Protein Science	Lb	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: BBT18L09	Subject Name :MINI PROJECT/ IMPLANT TRAINING / INDUSTRIAL TRAINING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	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:

- 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	Understand the process followed in research laboratory and industries for problem solving
CO2	Get acquainted with methodologies following research laboratories and industries
CO3	Develop the analytical skill towards problem solving

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	3	3	3	3	3
CO2	3	3	3	3	3	2	2	3	3	3	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L09	Subject Name : MINI PROJECT/ IMPLANT TRAINING / INDUSTRIAL TRAINING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All Core Subjects	L	0	0/0	3/0	1

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: BBT18TS3	Subject Name :TECHNICAL SKILLS - III	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	To get knowledge about the biotechnology skill through value added courses
CO2	Ability to understand the biotechnological contemporary issues
CO3	To enrich the thinking of students towards biotechnological problem solving skill

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	-	-	-	-	1	2	-	-
CO2	-	2	2	-	-	-	-	-	1	2	-	-
CO3	-	2	2	-	-	-	-	-	1	2	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18TS3	Subject Name :TECHNICAL SKILLS - III	T / 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

SEMESTER -VII

Subject Code: BBT18012	Subject Name :Downstream Processing	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess Engineering	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 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	To understand the basic fundamentals of downstream processing for biochemical product recovery.
CO2	To understand the basic principle of characterization of biomolecules and various cell disruption process.
CO3	To model biochemical product recovery, including small molecule purification

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	3	3	3
CO3	3	3	2

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18012	Subject Name :Downstream Processing	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess Engineering	TY	3	1/0	0/0	4

UNIT I - INTRODUCTION **12 Hrs**

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 **12 Hrs**

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

UNIT III - ISOLATION OF PRODUCTS **12 Hrs**

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 **12 Hrs**

Crystallization, drying and lyophilization in final product formulation.

UNIT V - INDUSTRIAL HYGIENE **12 Hrs**

Government regulations, Identification, Evaluation, Control. Designs to prevent fires and explosions: Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

Total no of Periods: 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: BMG18004	Subject Name : TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	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:

- Customer Perception on Quality and various dimensions of quality and International standards on Quality.

COURSE OUTCOMES (COs) : The students will have to know

CO1	Able to enumerate and justify the dimension of product quality and service quality
CO2	To identify and justify causes and sub causes for the given quality problem
CO3	To understand and apply the morals of quality assurance professionals

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	1	2	3	-	3	-
CO2	-	-	-	-	-	3	1	2	3	-	3	-
CO3	-	-	-	-	-	3	1	2	3	-	3	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BMG18004	Subject Name : TOTAL QUALITY MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Ty	3	0/0	0/0	3

UNIT I **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 IV **9 Hrs**

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 **9 Hrs**

Modern Trend and Concept in Manufacturing Management: Business processes reengineering (BPR) – Lean / flexible – manufacturing systems – Six sigma concept.

Total no of Periods: 45

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*

PRACTICALS
SEMESTER -VII

Subject Code: BBT18ET4	Subject Name :Food Biotechnology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology	ETL	1	0/1	3/0	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	Apply the concepts of biotechnology to the science of food
CO2	Interpret the principles of biotechnology in processing and preservation of food
CO3	Understand the microbial products used as additives as food

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	2	2	-	-	2	-	-	-	-
CO2	-	2	2	2	2	-	-	2	-	-	-	-
CO3	-	2	1	2	2	-	-	2	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	-	3
CO2	2	-	-
CO3	3	2	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18ET4	Subject Name :Food Biotechnology	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology	ETL	1	0/1	3/0	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 no of Periods: 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)*
   Sarah Elderidge, Food Biotechnology: Current Issues and Perspectives (2003)

Subject Code: BBT18L10	Subject Name :Downstream Processing Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess Engineering	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 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	To understand the separation of whole cells and other insoluble ingredient's from the culture broth
CO2	Developing skills to isolate intracellular products by cell disruption techniques
CO3	To analyze suitable method for product recovery based on purity requirement

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3				
CO1	3	2	3				
CO2	3	3	3				
CO3	2	3	3				

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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:	Subject Name :Downstream Processing Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18L10	Prerequisite: Bioprocess Lab	Lb	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

Subject Code: BBT18L11	Subject Name : Animal Tissue Culture Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	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 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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12
CO1	-	-	3	3	2	2	-	-	-	-	-	-
CO2	-	-	3	3	2	2	-	-	-	-	-	-
CO3	-	-	3	3	2	1	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	2	1	3
CO3	2	2	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code: BBT18L11	Subject Name : Animal Tissue Culture Lab	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	Lb	0	0/0	3/0	1

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: BBT18L12	Subject Name : PROJECT PHASE-I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Lb	0	0/0	3/3	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	Enable the students to understand and define aims and objectives of the problem statement
CO2	Familiarize them to frame the methodology for problem statement
CO3	Understand the basic concepts of operation process 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	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L12	Subject Name : PROJECT PHASE-I	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Lb	0	0/0	3/3	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.

Subject Code: BHS18FLX	Subject Name : Foreign Language	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	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 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	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	3	1
CO2	2	3	1
CO3	2	3	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

SEMSETER - VIII

Subject Code: BBT18013	Subject Name: LEGAL ASPECTS OF BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant biotechnology,Basic pharmaceutical science	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

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	Evaluate legal aspects of biotechnology and biosafety case studies
CO2	Apply the course conduct while working on biological agents
CO3	To understand the various biosafety and bioethics principle

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	-	-	2	1
CO2	-	-	-	-	-	2	2	3	-	-	2	1
CO2	-	-	-	-	-	2	2	3	-	-	2	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	1	1	1
CO3	1	1	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18013	Subject Name : LEGAL ASPECTS OF BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant Biotechnology, Basic Pharmaceutical Science	Ty	3	1/0	0/0	4

UNIT I - INTRODUCTION TO INTELLECTUAL PROPERTY **12 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 **12 Hrs**

History of GATT & TRIPS Agreement; Madrid Agreement; Hague, Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent, Act 1970 & recent amendments.

UNIT-III - FORMS **12 Hrs**

National and PCT filing procedure ; Time frame and cost; Status of the patent applications filed; Budapest while patenting – disclosure / non –disclosure; Financial assistance for patenting- introduction to existing schemes, patent licensing and agreement, patent infringement – meaning, scope, litigation, Case studies.

UNIT IV - BIOSAFETY **12 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 **12 Hrs**

Human genome project and its ethical issues. Gene testing, prenatal diagnosis, genetic manipulations, germline therapy, genetic studies on ethnic races.

Total no of Periods: 60

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*

PRACTICALS
SEMESTER -VIII

Subject Code: BBT18L14	Subject Name : PROJECT PHASE-II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	Lb	0	0/0	12/12	8

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

CO1	Enable the students to understand and define aims and objectives of the problem statement
CO2	Familiarize them to frame the methodology for problem statement
CO3	Understand the basic concepts of operation process 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	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18L14	Subject Name : PROJECT PHASE-II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: All core papers	**Lb**	**0**	**0/0**	**12/12**	**8**

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

ELECTIVE - I

Subject Code: BBT18E01	Subject Name : HERBAL DRUG TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Pharmaceutical	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 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	Understand medicinal plants, their secondary metabolites, and extraction techniques for obtaining phytopharmaceuticals.
CO2	Apply chromatography and spectroscopy methods for plant drug analysis and standardization of herbal drugs.
CO3	Develop skills in identifying and characterizing phytochemical compounds, and adhere to WHO guidelines for quality standardized herbal formulations.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E01	Subject Name : HERBAL DRUG TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Pharmaceutical	Ty	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 no of Periods: 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: BBT18E02	Subject Name :Environment Impact Assessment	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Solid and hazard waste management	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** 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	Understand the evolution, concepts, methodologies, and key components of Environmental Impact Assessment (EIA) and its associated processes such as screening, scoping, baseline studies, mitigation, and the use of matrices and checklists.
CO2	Apply legislative and environmental clearance procedures in India for conducting both rapid and comprehensive EIA, and utilize prediction tools to assess the potential environmental impacts of proposed projects.
CO3	Assess the impacts of various factors, including air, water, soil, noise, biological aspects, socio-cultural environment, and incorporate public participation, resettlement, and rehabilitation considerations in the EIA process.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E02	Subject Name :Environment Impact Assessment	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Solid and hazard waste management	Ty	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 no of Periods: 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: BBT18E03	Subject Name : STEM CELLS AND DEVELOPMENTAL BIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	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 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	Understand the principles of developmental biology, including the genetic core of development, differential gene expression, cell commitment, differentiation, induction of cell fate, and cell-cell communication in development.
CO2	Gain knowledge of early embryonic development in various organisms, including invertebrates, Drosophila, amphibians, fish, birds, and mammals, with a focus on axis specification and formation.
CO3	Familiarize with the concept of stem cells, including their definition, classification, properties, and application of embryonic stem cells. Explore the development of differentiated tissues from embryonic germ layers, the function of placenta, amniotic fluid, and umbilical cord, and the hierarchy and properties of hematopoietic stem cells (HSCs).

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E03	Subject Name : STEM CELLS AND DEVELOPMENTAL BIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	Ty	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*

ELECTIVE - II

Subject Code: BBT18E04	Subject Name :Protein Science	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	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 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	Understand the structure and classification of proteins, including the classification of amino acids, primary, secondary, tertiary, and quaternary protein structures, protein stability, and denaturation.
CO2	Gain knowledge of various methods used to characterize proteins in solution, such as absorbance, fluorescence, circular dichroism, X-ray crystallography, nuclear magnetic resonance spectroscopy, mass spectrometry, and protein sequencing.
CO3	Familiarize with protein motifs, including helix-turn-helix motifs, beta structures, folding and flexibility, and their role in signal transduction, membrane proteins, and fibrous proteins. Also, explore protein engineering, including protein folding, prediction and design, protein structure prediction and modeling, and the role of protein interactions in diseases.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E04	Subject Name :Protein Science	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry & Microbial Technology	Ty	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.

UNIT V - 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 no of 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: BBT18E05	Subject Name : BIOFUELS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	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 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	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E05	Subject Name : BIOFUELS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	Ty	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 no of 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: BBT18E06	Subject Name : SOLID AND HAZARDOUS WASTE MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Chemical Reaction 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 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 types and sources of solid and hazardous wastes, and the need for effective waste management, including legislation pertaining to municipal solid wastes, hazardous wastes, and biomedical wastes.
CO2	Gain knowledge of waste generation rates, waste composition, hazardous characteristics, waste sampling, and the importance of source reduction, recycling, and reuse in waste management.
CO3	Familiarize with the handling and segregation of wastes at the source, storage and collection of municipal solid wastes, transfer and transport requirements, labeling and handling of hazardous wastes, and the analysis of collection systems in waste management.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E06	Subject Name : SOLID AND HAZARDOUS WASTE MANAGEMENT	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/Microbial Technology	Ty	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.

UNIT V - 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 no of 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*

ELECTIVE - III

Subject Code: BBT18E07	Subject Name : CANCER BIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology / Molecular Biology	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

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 fundamental principles of cancer biology, including cell cycle regulation, mutations, tumor suppressor genes, and the role of diet in cancer development.
CO2	Gain knowledge of the principles of carcinogenesis, including chemical and physical factors, metabolism, and radiation-induced carcinogenesis.
CO3	Familiarize with the principles of molecular cell biology of cancer, including signal targets, oncogenes, growth factors, and the role of telomerases in cancer development.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	1	-	-	-	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E07	Subject Name : CANCER BIOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology / Molecular Biology	Ty	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 CANCER METASTASIS **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 no of 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)*

Subject Code: BBT18E08	Subject Name : MOLECULAR PATHOGENESIS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/ Cell Biology / Molecular Biology	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

OBJECTIVES:

- To understand the fundamentals of pathogenesis at molecular level, mode of entry of pathogens into host, its defense mechanisms, therapeutic approaches etc

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the historical perspective and key discoveries in the field of microbiology, including the contributions of Louis Pasteur and Robert Koch, the discovery of microbial toxins, and the development of vaccines and antibiotics.
CO2	Explain the host defense mechanisms against pathogens, including physical barriers, immune responses, inflammation, and the role of antimicrobial compounds. Also, describe the strategies employed by pathogens to overcome host defenses.
CO3	Gain knowledge of molecular pathogenesis through specific examples, including the virulence factors and mechanisms of pathogenicity of various pathogens such as Vibrio cholerae, E. coli, Shigella, Plasmodium, and Influenza virus.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	1	-	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E08	Subject Name : MOLECULAR PATHOGENESIS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology/ Cell Biology / Molecular Biology	Ty	3	0/0	0/0	3

UNIT I - OVERVIEW **5 Hrs**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics, Various pathogen types and modes of entry.

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

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

UNIT III - MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **16 Hrs**

Virulence, virulence factors, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens, Shigella: Entry and its cycle, Plasmodium entry and Life cycle, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine.

UNIT IV - EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS **8 Hrs**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors

UNIT V - MODERN APPROACHES TO CONTROL PATHOGENS **8 Hrs**

Classical approaches based on serotyping. Modern diagnosis : immuno & DNA-based techniques. New therapeutic strategies: Vaccines - DNA, subunit and cocktail vaccines.

Total no of Hours: 45

REFERENCES

1. Iglewski B.H and Clark V.L " Molecular basis of Bacterial Pathogenesis ", Academic Press, 1990.

2. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology : Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.

3. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc

4. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", Mc Graw Hill, 3rd Edition, 2001.

5. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

Subject Code:	Subject Name : MARINE BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18E09	Prerequisite: Microbiology	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 Understand the basic concepts of marine environment. To give an idea about different types of microbes in marine environment. To gain knowledge in application of marine metabolites.

COURSE OUTCOMES (COs) : By doing this course students will acquire basic fundamental knowledge

CO1	Understand the diversity and characteristics of marine flora and fauna, including phytoplankton, seaweeds, sea grasses, zooplankton, major marine invertebrates, vertebrates, and marine mammals.
CO2	Identify and classify marine microbes, including their types, methods of culturing, identification, and preservation.
CO3	Explore the role of marine microbes in nutrient cycling, such as microbial nitrogen fixation, carbon, phosphorus, and sulfur cycles, degradation of organic matter, microbial leaching, and biofouling.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	1	-	-	-	-	-
CO2	-	3	-	2	-	1	-	-	-	-	-	-
CO3	-	-	-	-	3	-	-	2	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E09	Subject Name :MARINE BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Microbiology	Ty	3	0/0	0/0	3

UNIT 1 - INTRODUCTION **9 Hrs**

Introduction to marine environment; Marine Flora – Phytoplankton, seaweeds, sea grasses and mangroves-their characteristics and identification; Biology

UNIT II - MARINE FAUNA **9 Hrs**

Marine fauna-zooplankton; major marine invertebrates; vertebrates and marine mammals-characteristics and identification, Biology

UNIT III - MARINE MICROBES **9 Hrs**

Marine microbes – Types, classification, methods of culturing and identification; methods of preservation.

UNIT IV - MARINE MINERAL CYCLE **9 Hrs**

Microbial Nitrogen fixation, their role in carbon, phosphorous and sulphur cycle,, degradation of organic matter; Microbial leaching and Biofouling

UNIT V - MARINE PHARMACOLOGY **9 Hrs**

Marine pharmacology – Microbial metabolites; Metabolites from marine flora and fauna

Total no of Hours: 45

TEXT BOOK

Bhakuni, D.S., Rawat, D.S. 2005. Bioactive Marine Natural Products. Springer,

Subject Code:	Subject Name :ANIMAL TISSUE CULTURE	T / L/ ETL	L	T / S.Lr	P/ R	C
BBT18E10	Prerequisite: Cell Biology	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 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	Understand the design, layout, and equipment required for a cell culture laboratory, including sterile handling areas, incubators, refrigerators, centrifuges, and microscopes.
CO2	Demonstrate knowledge of cell culture media and reagents, including their composition, physicochemical properties, sterilization techniques, and selection criteria for different cell types.
CO3	Describe different types of cell cultures, such as primary cultures, continuous cell lines, suspension cultures, and organ cultures, and understand their behavior, maintenance, and applications in cloning, transfection, production of vaccines, and drug testing.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	3	-	-	-	2	-	-	1	-	-
CO2	3	-	-	2	-	-	-	1	-	-	-	-
CO3	-	3	-	-	2	-	-	-	-	-	-	1

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E10	Subject Name :ANIMAL TISSUE CULTURE	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology	Ty	3	0/0	0/0	3

UNIT I - CELL CULTURE LABORATORY DESIGN & EQUIPMENTS **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

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 no of Hours: 45

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)*

ELECTIVE - IV

Subject Code: BBT18E11	Subject Name: ADVANCES IN AGRICULTURAL BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant Biotechnology/RDNA/Genetics	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

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	Understanding the concept and application of molecular markers in crop and animal improvement.
CO2	Applying genetic engineering techniques for developing disease-resistant plants and improving abiotic stress tolerance.
CO3	Exploring the use of transgenic animals for enhancing farming practices and producing valuable products.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	3	2	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	3	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E11	Subject Name: ADVANCES IN AGRICULTURAL BIOTECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Plant Biotechnology/RDNA/Genetics	Ty	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 no of 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: BBT18E12	Subject Name : BIOMATERIALS AND TISSUE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: CellBiology/Tissue culture	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

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	Understand the different types of biomaterials, including natural and synthetic polymers, their processing techniques, and their applications in tissue engineering and regenerative medicine.
CO2	Demonstrate knowledge of the properties and characteristics of natural biopolymers and synthetic polymers used in biomaterials, including their chemical modification, scaffold fabrication, and interaction with cells and tissues.
CO3	Gain an understanding of the engineering principles involved in the design and construction of functional cell constructs, tissue engineering scaffolds, and bioartificial devices, as well as the regulatory and safety considerations in the field of biomaterials.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	3	-	-	3	-	-	-	-	-
CO2	-	2	-	-	2	-	-	-	-	-	-	-
CO3	1	-	-	-		-	-	-	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E12	Subject Name : BIOMATERIALS AND TISSUE ENGINEERING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Cell Biology/Tissue culture	Ty	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

Subject Code: BBT18E13	Subject Name : ENVIRONMENTAL TOXICOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology/Solid hazardous waste water Management	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

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 presence of toxic chemicals in the environment, their sources, and their effects on air, water, and biochemical processes. Gain knowledge of specific toxic chemicals such as arsenic, cadmium, lead, mercury, carbon monoxide, ozone, and pesticides.
CO2	Comprehend the modes of entry for toxic substances into the environment and the process of biotransformation and detoxification of xenobiotics. Explore the mechanisms of how toxic chemicals enter and interact with biological systems.
CO3	Develop an understanding of carcinogens present in the air, their chemical carcinogenicity, and the mechanisms by which they cause cancer. Learn about the environmental testing of carcinogens and their impact on human health.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
COG2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E13	Subject Name: ENVIRONMENTAL TOXICOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Microbiology/Solid hazardous waste water Management	Ty	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 no of 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)*

Subject Code: BBT18E14	Subject Name :PHARMACEUTICAL TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: 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:

- The goal is to emphasize the importance of pharmaceutical research and its usefulness in biotechnology. To impart basic concepts of drug metabolism and pharmacokinetics, manufacturing principles, and biopharmaceuticals.

COURSE OUTCOMES (COs) : By doing this course students will acquire basic fundamental knowledge

CO1	Understand the fundamentals of the pharmaceutical industry, including regulatory aspects, routes of drug administration, and the different types of therapeutic agents.
CO2	Demonstrate knowledge of pharmacokinetics and pharmacodynamics, including the absorption, distribution, metabolism, and excretion of drugs, as well as the mechanisms of drug action and the process of new drug discovery.
CO3	Gain an understanding of the principles of drug manufacture, including tablet and capsule preparation, formulation techniques, quality management, and the analytical methods used in drug manufacturing.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	2	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	3	2	1	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E14	Subject Name :PHARMACEUTICAL TECHNOLOGY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry	Ty	3	0/0	0/0	3

UNIT I - INTRODUCTION **9 Hrs**

Introduction to Pharmaceutical Industry, Regulatory aspects, Routes of Administration of Drugs and types of therapeutic agents.

UNIT II - PHARMACOKINETICS AND PHARMACODYNAMICS **9 Hrs**

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 **9 Hrs**

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 **9 Hrs**

Various categories of therapeutics like laxatives, analgesics, contraceptives, hormones and Antibiotics

UNIT V - PHARMACEUTICAL PATENTS **9 Hrs**

Introduction about the Patents related to Pharmaceutical Natural Products

Total no of 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.*

ELECTIVE - V

Subject Code: BBT18E15	Subject Name : BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Immunology/IMA	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

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	Understand the fundamentals of biosensors, including their construction, transduction principles, and the sensitivity, specificity, and linearity of biological sensing elements and transducer systems.
CO2	Identify and differentiate between different types of biosensors, such as thermometric sensors, optoelectronic sensors, electrochemical sensors, flow injection analysis-based biosensors, and affinity biosensors. Understand their principles of operation and applications.
CO3	Explore the applications of biosensors in clinical analysis, including their use in personal diabetes management, noninvasive clinical analysis, and healthcare. Also, understand the non-clinical applications of biosensors in fields such as veterinary, agriculture, food production, environmental control, pollution monitoring, and bioprocess industry.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	-	-	-	-	-	-	-	-
CO2	-	-	-	2	3	1	-	-	-	-	-	-
CO3	-	-	-	-	-	-	1	3	2	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E15	Subject Name : BIOSENSORS AND BIOMEDICAL DEVICES IN DIAGNOSTICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Biochemistry/Immunology/IMA	Ty	3	0/0	0/0	3

UNIT I - FUNDAMENTALS OF BIOSENSORS **9 Hrs**

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 no of 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: BBT18E16	Subject Name : CLINICAL GENETICS AND CYTOGENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/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

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	Understand the inheritance patterns in humans, including Mendelian inheritance, dominant, recessive, lethal, sex-linked, sex-influenced, multifactorial, and mitochondrial inheritance. Gain knowledge about genetic diseases affecting various organs such as the heart, lungs, kidneys, brain, and sex organs.
CO2	Explain the chromosome basis of inheritance, including autosomal, sex, and micro chromosomal anomalies. Learn cytogenetic techniques, including the nomenclature of banded chromosomes according to ISCN (International System for Human Cytogenomic Nomenclature) guidelines.
CO3	Develop proficiency in banding techniques used in chromosome analysis, such as Q-Banding, G-Banding, R-Banding, Acridine orange R-Banding, C-Banding, DAPI, NOR Banding, etc. Interpret karyotypes, classify unbanded chromosomes, and understand HRB (High-Resolution Banding) nomenclature.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	-	-	-	-	-	-	-	-
CO2	-	-	-	2	3	1	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	2	3	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – 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: BBT18E16	Subject Name CLINICAL GENETICS AND CYTOGENETICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Genetics/Biochemistry	Ty	3	0/0	0/0	3

UNIT I - INHERITANCE PATTERN IN MAN **9 Hrs**

Mendelian inheritance, dominant, recessive, lethal, sex linked, sex influenced, multifactorial and mitochondrial inheritance. Genetic Diseases of heart, lungs, Kidney, brain and sex organs.

UNIT II - CHROMOSOME BASIS OF INHERITANCE: **9 Hrs**

Autosomal, sex and micro chromosomal anomalies, cytogenetic techniques and nomenclature of banded chromosomes, ISCN 1980, 1990.

UNIT III - BANDING TECHNIQUE: **9 Hrs**

Differential staining: Q-Banding, G- banding, R-banding, Acridine orange R-banding, Cbanding, DAPI, C-banding, NOR banding. HRB, chromosome Fragile sites, PCC (premature chromosome condensation), Karyotype interpretation classification of unbanded chromosomes, Nomenclature of banded mitotic chromosomes, HRB nomenclature.

UNIT IV - PREPARATION OF PROBES AND ITS CLASSIFICATION **9 Hrs**

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)

UNIT V- APPLICATION OF FISH: **9 Hrs**

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.

Total no of Hours: 45

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.*

Subject Code: BBT18E17	SUBJECT NAME : BIOREMEDIATION OF INDUSTRIAL EFFLUENTS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess technology/environment biotechnology	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

OBJECTIVES:

- To understand the various methods for effluent treatment.To understand the basic in designing bioreactor. To gain knowledge about the industrial effluent treatment.

COURSE OUTCOMES (COs) : After studying this course the student would be able to

CO1	Understand the fundamentals of bioremediation, including the introduction to effluent treatment and a comparison of chemical, physical, and biochemical methods. Gain knowledge about the microbial flora of soil and the growth and interactions among soil microorganisms.
CO2	Familiarize with the types of bioreactors used for industrial applications, specifically for aerobic and anaerobic treatment strategies.
CO3	Develop mathematical design approaches for bioreactors, including basic reactor designs, gas transport processes, and the activated sludge process.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	3	1	2	-	-	-	-	-	-	-	-	-
CO2	-	-	-	2	3	1	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	2	3	-	-	-

COs / PSOs	PSO1	PSO2	PSO3
CO1	2	1	3
CO2	1	3	2
CO3	3	2	1

3/2/1 indicates strength of correlation 3 – High, 2 – Medium, 1 – Low

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

Subject Code: BBT18E17	Subject Name : BIOREMEDIATION OF INDUSTRIAL EFFLUENTS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Bioprocess technology/environment biotechnology	Ty	3	0/0	0/0	3

UNIT I - FUNDAMENTALS OF BIOREMEDIATION **8 Hrs**

Introduction to effluent treatment, Comparison of chemical, physical and biochemical methods, Microbial flora of soil. Growth, interactions among soil microorganisms

UNIT II - BIOREACTORS FOR INDUSTRIAL APPLICATIONS **7 Hrs**

Type of reactors for aerobic and anaerobic treatment strategies

UNIT III - MATHEMATICAL DESIGN APPROACHES **7 Hrs**

Basic reactor designs, gas transport process, activated sludge process

UNIT IV - TREATMENT OF INDUSTRIAL LIQUID EFFLUENTS **15 Hrs**

Dairy, pulp, dye, leather, pharamaceuticals etc. Comparison of various liquid wastes

UNIT V - TREATMENT OF SOLID AND GASEOUS EFFLUENTS **8 Hrs**

Various techniques, reactors, organisms

Total no of Hours: 45

TEXT BOOKS

1. Environmental Biotechnology, Principles and applications, Bruce E.Rittman and Perry L.Mac Carty,Mc GrawHill, NewYork, 2001.

2. Doble Mukesh, & Anil Kumar, Biotreatment of industrial effluents, Elsevier, New York, Feb,