VINAYAKA MISSION'S RESEARCH FOUNDATION, SALEM (Deemed to be University)

FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS-2015

CURRICULUM

I TO VIII SEMESTER

FOR

B.Tech. BIOTECHNOLOGY (REGULAR)

I SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		English for Engineers	English	**3**	**0**	**0**	**3**
2.		Physics for Engineers	Physics	**3**	**0**	**0**	**3**
3.		Mathematics for Bioengineering	Maths	**3**	**1**	**0**	**4**
4.		Fundamentals of Biotechnology	Biotechnology	**3**	**0**	**0**	**3**
5.		Essentials of Computer Science and Engineering	Computer Science	**3**	**0**	**0**	**3**
6.		Biochemistry I	Biotechnology	**3**	**1**	**0**	**4**
PRACTICAL							
7.		Physics Lab	Physics	**0**	**0**	**4**	**2**
8.		Computer Lab	Computer Science	**0**	**0**	**4**	**2**
9.		Biochemistry I Lab	Biotechnology	**0**	**0**	**4**	**2**
		TOTAL		**18**	**2**	**12**	**26**

II SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Business English	English	**3**	**0**	**0**	**3**
2.		Professional Ethics & Human Values	Management	**3**	**0**	**0**	**3**
3.		Biochemistry- II	Biotechnology	**3**	**0**	**0**	**3**
4.		Biostatistics	Maths	**3**	**1**	**0**	**4**
5.		Bioinstrumentation	Biotechnology	**3**	**1**	**0**	**4**
6.		C Programming	Comp. Science & Engineering	**3**	**0**	**0**	**3**
PRACTICAL							
7.		Biochemistry- II Lab	Biotechnology	**0**	**0**	**4**	**2**
8.		Bioinstrumentation Lab	Biotechnology	**0**	**0**	**4**	**2**
9.		C programming Lab	Comp. Science & Engineering	**0**	**0**	**4**	**2**
10.		Yoga and meditation Lab		**0**	**0**	**1**	**1**
		TOTAL		**18**	**2**	**13**	**27**

III SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Cell Biology	Biotechnology	**3**	**1**	**0**	**4**
2.		Microbiology	Biotechnology	**3**	**0**	**0**	**3**
3.		Classical and Molecular Genetics	Biotechnology	**3**	**0**	**0**	**3**
4.		Bio-organic Chemistry	Biotechnology	**3**	**0**	**0**	**3**
5.		Environmental Science and Engineering	Chemistry	**3**	**0**	**0**	**3**
6.		Unit Operations in process Industries	Biotechnology	**3**	**1**	**0**	**4**
PRACTICAL							
7.		Cell Biology Lab	Biotechnology	**0**	**0**	**4**	**2**
8.		Microbiology Lab	Biotechnology	**0**	**0**	**4**	**2**
9.		Bio-organic Chemistry Lab	Biotechnology	**0**	**0**	**4**	**2**
		TOTAL		**18**	**2**	**12**	**26**

IV SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Molecular Biology	Biotechnology	**3**	**0**	**0**	**3**
2.		Enzyme Engineering and Technology	Biotechnology	**3**	**1**	**0**	**4**
3.		Plant and Animal diseases and their control	Biotechnology	**3**	**0**	**0**	**3**
4.		Principles of Chemical Engineering	Biotechnology	**3**	**1**	**0**	**4**
5.		Ocean Science	Biotechnology	**3**	**0**	**0**	**3**
6.		Principle of Bioinformatics	Biotechnology	**3**	**1**	**0**	**4**
PRACTICAL							
7.		Molecular Biology Lab	Biotechnology	**0**	**0**	**4**	**2**
8.		Chemical Engineering Lab	Biotechnology	**0**	**0**	**4**	**2**
9.		Professional Communication and Personality Development Lab	English	**0**	**0**	**4**	**2**
		TOTAL		**18**	**3**	**12**	**27**

V SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Immunology	Biotechnology	**3**	**0**	**0**	**3**
2.		Genetic Engineering	Biotechnology	**3**	**1**	**0**	**4**
3.		Protein Engineering	Biotechnology	**3**	**0**	**0**	**3**
4.		Diagnostics and Therapeutics	Biotechnology	**3**	**0**	**0**	**3**
5.		Thermodynamics for Biotechnology	Biotechnology	**3**	**1**	**0**	**4**
6.		Elective I	Biotechnology	**3**	**0**	**0**	**3**
PRACTICAL							
7.		Immunology Lab	Biotechnology	**0**	**0**	**4**	**2**
8.		Genetic Engineering Lab	Biotechnology	**0**	**0**	**4**	**2**
		TOTAL		**18**	**2**	**8**	**24**

VI SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Plant and Animal Biotechnology	Biotechnology	**3**	**0**	**0**	**3**
2.		Genomics and Proteomics	Biotechnology	**3**	**0**	**0**	**3**
3.		Genetically Modified Organisms and ethical Issues	Biotechnology	**3**	**0**	**0**	**3**
4.		Bioprocess Engineering	Biotechnology	**3**	**1**	**0**	**4**
5.		Mass Transfer Operations	Biotechnology	**3**	**1**	**0**	**4**
6.		Elective II	Biotechnology	**3**	**0**	**0**	**3**
PRACTICAL							
7.		Plant and Animal Biotechnology Lab	Biotechnology	**0**	**0**	**4**	**2**
8.		Bioprocess Engineering Lab	Biotechnology	**0**	**0**	**4**	**2**
		TOTAL		**18**	**2**	**8**	**24**

VII SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Food Processing Technology	Biotechnology	**3**	**0**	**0**	**3**
2.		Biopharmaceuticals	Biotechnology	**3**	**0**	**0**	**3**
3.		Downstream Processing in Biotechnology	Biotechnology	**3**	**1**	**0**	**4**
4.		Nanobiotechnology	Biotechnology	**3**	**1**	**0**	**4**
5.		Stem Cell Biology and Tissue Engineering	Biotechnology	**3**	**1**	**0**	**4**
6.		Waste Management	Biotechnology	**3**	**0**	**0**	**3**
PRACTICAL							
1.		Food Processing Technology Lab	Biotechnology	**0**	**0**	**4**	**2**
2.		Downstream Processing Engineering Lab	Biotechnology	**0**	**0**	**4**	**2**
		TOTAL		**18**	**3**	**8**	**25**

VIII SEMESTER

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Elective III	Biotechnology	**3**	**0**	**0**	**3**
2.		Elective IV	Biotechnology	**3**	**0**	**0**	**3**
3.		Elective V	Biotechnology	**3**	**0**	**0**	**3**
4.		Project Work & Viva Voce	Biotechnology	**0**	**0**	**12**	**6**
		TOTAL		**9**	**0**	**12**	**15**

TOTAL CREDITS : 194

ELECTIVE LIST

S. No.	Course Code	Course Title	Dept. Offering the course	L	T	P	C
THEORY							
1.		Cancer Biology	Biotechnology	3	0	0	3
2.		Bioindustries and entrepreneurship	Biotechnology	3	0	0	3
3.		Drug Testing & Clinical Trials	Biotechnology	3	0	0	3
4.		Plant Metabolites & Metabolomics	Biotechnology	3	0	0	3
5.		Bioprocess Economics and Reactor Design	Biotechnology	3	0	0	3
6.		Total Quality Management	Management	3	0	0	3
7.		Cryopreservation Theory and Applications	Biotechnology	3	0	0	3
8.		Immunotechnology	Biotechnology	3	0	0	3
9.		Women and Environment	Biotechnology	3	0	0	3
10.		Limnology	Biotechnology	3	0	0	3
11.		Metabolic Engineering	Biotechnology	3	0	0	3
12.		Material Science and Technology	Biotechnology	3	0	0	3
13.		Bioreactor Theory	Biotechnology	3	0	0	3
14.		Applied Biotechnology	Biotechnology	3	0	0	3
15.		Process Economics and Industrial Management	Biotechnology	3	0	0	3
16.		Disaster Mitigation and Management	Civil	3	0	0	3

I SEMESTER

YEAR	I	ENGLISH FOR ENGINEERS	L	T	P	C
SEMESTER	I		3	0	0	3

(COMMON TO ALL BRANCHES)

OBJECTIVES

- To enable students to develop LSRW skills in English.
- To become effective communicators in English.
- To ensure that learners use Electronic media materials for developing language skills.

OUTCOMES:

1. By teaching this syllabus, our UG Engineering graduates will enable to enhance wide range vocabulary to use at right place in right time.
2. Students who undergo this syllabus will fulfill practice in professional writing and comprehension skill and meet the industry requirements.

UNIT – I **9**

Self introduction - Simulations using E Materials - Whatsapp, Face book, Hiker, Twitter- Effective Communication with Minimum Words - Interpretation of Images and Films - Identify the different parts of speech– Common Errors in English – Scientific Vocabulary, (definition and meaning) - Listening Skills- passive and active listening, Listening to native speakers, , guided note taking - Characteristics of a good listener– Telephonic conversation with dialogue.

UNIT – II **9**

Articles - Phonetics (Vowels, Consonants and Diphthongs) – Pronunciation Guidelines –Listening to Indian speakers from different regions, intrusion of mother tongue – Homophones – Homonyms, Note taking and Note making - Difference between Spoken and Written English- Use of appropriate language - Listening and Responding to Video Lectures (Green India, environment, social talks) - Extempore.

UNIT – III **9**

Tense forms- Verbal & Non verbal communication – Describing objects – Process Description- Speaking Practice – Paragraph Writing on any given topic (My favourite place, games / Hobbies / School life, etc.) –Types of paragraphs- Telephone Etiquettes.

UNIT – IV **9**

Impersonal Passive Voice- Conditional Sentences – Technical & Non technical Report Writing (Attend a technical seminar & submit a report) – News Letters & Editing – Skimming & Scanning - How to Improve Reading Speed – Designing Invitations & Poster Preparation.

UNIT – V **9**

Sentence Pattern (SVOCA) - Statement of Comparison - Transcoding – Informal letters - SWOT analysis– Resume Writing- Difference –Bio – data, Resume and CV.

Total: 45 hours

TEXT BOOK

1 **English for Effective Communication,** Departments of English, VMKV & AVIT. Erode: SCM Publishers, 2009.

REFERENCE BOOKS

1 M.Ashraf Rizvi, Effective Technical Communication. New Delhi: Tata McGraw Hill Publications, 2007.
2 Pickett and Laster. Technical English: Writing, Reading and Speaking. New York: Harper and Row Publications, 2002.
3 Cutts, Martin. The Plain English Guide – How to Write Clearly and Communicate Better. New Delhi: Oxford University Press, 1995.
4 Narayanaswami.V.R. Strengthen Your Writing. Chennai: Orient Longman Ltd., 1996.
5 Prof.K.R.Lakshmi Narayanan & Dr.T.Murugavel, Communication Skills for Engineers, Chennai: SCI Publications, 2002.

SEMESTER	CODE	SUBJECT	L	T	P	C
I		PHYSICS FOR ENGINEERS	3	0	0	3

AIM:

To familiarize students with the basic concepts of Physics and their application in Engineering & Technology.

OBJECTIVE:

- To understatnd the elastic properties of materials
- To understatnd the properties of crystals
- To understatnd the significance of laser and its applications in technology
- To understatnd the basic principles of optical fibres and their applications
- To understatnd the Non-Destructive Testing techniques

OUTCOME:

- The fundamental knowledge in physics will improve the scientific thinking of students

UNIT I –Properties of matter **9**

Elasticity – Hooke's law – Stress-strain diagram - Relationship between three moduli of elasticity (qualitative) - Poisson's ratio – Young's modulus by uniform bending and non-uniform bending – Experimental determination of rigidity modulus – I-shaped girders.

UNIT II – Crystal Physics **9**

Unit cell – Bravais lattice – Miller indices – Calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures – Crystal imperfections – point, line, surface and volume defects.

UNIT III – Lasers **9**

Laser characteristics - Stimulated Emission – Population Inversion - Einstein coefficients – Lasing action – Types of Laser – Nd:YAG laser, CO_2 laser, GaAs laser – Applications of Laser – Holography – construction and reconstruction of a hologram

UNIT IV – Fibre Optics **9**

Principle and propagation of light in optical fibres – numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – Applications: Fibre optic communication system – fibre optic displacement sensor and pressure sensor.

UNIT V - Non – Destructive Testing **9**

Introduction – Types of NDT - Liquid penetrant method – characteristics of penetrant and developer - ultrasonic flaw detector – Ultrasonic scanning methods - X-ray Radiography: displacement method – X-ray Fluoroscopy.

Total hours : 45

TEXT BOOK

"Engineering Physics", compiled by Department of Physics, Vinayaka Missions University, Salem.

REFERENCE BOOKS

1. Beiser, Arthur, "Concepts of Modern Physics", 5th Ed., McGraw-Hill, 2009.

2. Halliday.D, Resnick.R, Walker.J, Fundamentals of Physics, Wiley & sons, 2013.

3.Gaur R. K. and Gupta S. L., "Engineering Physics", Dhanpat Rai publishers, New Delhi, 2001.

4. Avanadhanulu.M.N., Arun Murthy.T.V.S, Engineering Physics Vol. I, S.Chand, 2014.

5. Rajendran. V, "Engineering Physics", Tata Mc Graw Hill Publication and Co., New Delhi, 2009.

YEAR	SEMESTER	TITLE OF PAPER	L	T	P	C
I	I	**MATHEMATICS FOR BIO-ENGINEERING** **Common to BE** Bio.Tech and BIF First Semester	3	1	0	4

Aim:

To provide students with mathematical knowledge and skills needed to support their concurrent and subsequent engineering and science studies

Objective:

- To provide the students with the concept and an understanding of Differential equations.
- To impart the knowledge of the applications of integration.
- To orient the students to know about the application of Harmonic analysis.
- To teach the students about the solutions of wave and heat equations.
- To motivate the students to know about the applications of Fourier Series

Outcome:

- Update the knowledge with different kind of integrations.
- Develop the skills in solving differential equations.
- Relate the properties of Fourier series with their engineering subjects during their course of study
- Apply the knowledge gathered in the subject to Signal processing
- Gain the knowledge in vibrations of stretched strings.
- Develop the fundamental ideas of D Alembert's solution of the wave equation
- Understand the concepts of Steady state conditions

UNIT I: DIFFERENTIAL CALCULUS

Ordinary Differentiation – Basic Concepts – Slope – Maxima, Minima of a function of a single variable – Second order derivates – Partial Differentiation– maxima and minima of a function of two variables

UNIT II: INTEGRATION

Concept of integration-Integration of Rational and Trigonometric functions – Using Partial Fractions – Substitutions – Integration by parts.

UNIT III: ORDINARY DIFFERENTIAL EQUATION

Formation of differential equations – Solution of first order equation – Variable separable and solution of Linear differential equation of the form $\frac{dy}{dx} + Py = Q$ - Linear Second Order ordinary differential equation with constant coefficients (e^{ax} ,cosax,sinax)

UNIT IV: FOURIER SERIES

Dirichlet's conditions - General Fourier series - Half-range Sine and Cosine series.

UNIT V: ONE DIMENSIONAL & TWO DIMENSIONAL HEAT EQUATIONS

Solution of heat equation, Equations with zero boundary values, Steady state with zero boundary conditions. Solution of Laplace equation, Steady state temperature in finite plates- Non zero condition given in x direction, Non zero condition given in y direction.

TEXT BOOK:

1. **"**Engineering Mathematics**"** by Department of Mathematics, VMU
   Veerarajan, T., "Engineering Mathematics", Tata McGraw Hill Publishing Co., NewDelhi, 2006.
2. Dr.A .Singaravelu , Engineering Mathematics Volume I & Volume II by Meenakshi Publications.
3. A.Singaravelu,"Transforms and Partial Differential Equations", Meenakshi Agencies,Chennai

REFERENCES:

1. Grewal, B.S., "Higher Engineering Mathematics" (36th Edition), Khanna Publishers, Delhi 2001.
2. Kreyszig, E., "Advanced Engineering Mathematics" (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Kandasamy .P., Thilagavathy. K., and Gunavathy. K., "Engineering Mathematics", Volumes I & II (4th edition), S.Chand & Co., New Delhi., 2001.
4. T. Veerarajan, "Engineering Mathematics" (for semester III), Third Edition Tata McGraw- Hill Publishing Company limited.

YEAR	I	FUNDAMENTALS OF BIOTECHNOLOGY	L	T	P	C
SEMESTER	I		3	0	0	3

AIM

To offer a focused study on the important aspects of Biotechnology.

OBJECTIVES

To understand the basic concepts of the followings

- Scope and importance of Food Biotechnology
- Role in medicine
- Treatment of Wastes
- Bioremediation

OUTCOMES

- Demonstrate understanding of fundamental vocabulary and concepts of biotechnology
- Demonstrate ability to communicate concepts in written form
- Demonstrate ability of critically evaluate new biotechnology.

UNIT I

FOOD, FEED BIOTECHNOLOGY **9**

Scope and importance of Food Biotechnology, Arctic Apples, Golden Rice, Flavr- Savr Tomato,Bt- potatoes,Virus resistant Squash, Fermented Food, Single Cell Protein – Spirulina,

UNIT II

AGRICULTURAL BIOTECHNOLOGY **9**

Basics of plant tissue culture – callus induction, organogenesis, embryogenesis – embryo rescue, somatic embryogenesis, somaclonal variation, artificial seeds, secondary metabolites and their uses, Protoplast technology – hybrids and Cybrids, Biofertilizer, Biological Pest Control.

UNIT III **9**

ANIMAL BIOTECHNOLOGY

Transgenic animals – Knock out mice, chimeric mice, Baculoviruses and transgenic silkworm, Hybridoma Technique for Monoclonal antibodies, Pharmaceuticals from animal

systems, Animal bioreactors to produce therapeutic proteins, Karyotyping, Fish - Fluorescent in situ hybridization.

UNIT IV **9**

MEDICINAL BIOTECHNOLOGY

Industrial Enzyme production: α-amylase, cellulase, protease and lipase, Recombinant protein production: Insulin and interferon, Antibiotic production: Penicillin- Synthetic and Semisynthetic and Bacitracin(Novartis and Genetech), GeneTheraphy, Clinical Diagnosis using electronic devices (PCR, ELISA, Glucometer, RIA, Biosensor).

UNIT V **9**

ENVIRONMENTAL BIOTECHNOLOGY

Bioremediation, advantages and disadvantages; In situ and exsitu bioremediation; slurry bioremediation, Recent approaches to biological waste water treatment – Oxidation Ponds, Primary and Secondary Treatment,Textile Industry – Microbial Indigo, Lignolytic Enzymes, Composting process and techniques, Pollution – Air, water and Land, Energy – Wind mill, Solar Devices.

Total Hours : 45

TEXT BOOKS

1. Gupta, P.K. Elements of Biotechnology. Rastogi Publications, 2nd Edition 2010.

2. Satyanarayana. U., 2005. Biotechnology, Books and Allied Pvt Ltd.

REFERENCES

1. John E. Smith. Biotechnology. Cambridge Press. 3rd Edn., 2005.

2. Glazer, A. and Noickaido, 1995. Microbial Biotechnology-Fundamentals of Applied Microbiology, Cambridge University Press, 2nd Edition, 2007.

3. Jogdand, S.N., 2003. Environmental Biotechnology. Himalaya Publishing House.

4. Kumar, H.D. Modern Concepts and Biotechnology. Vikas Publishing House Pvt. Ltd, 1998.

5. Textbook of biotechnology by R.C. Dubey-2001, S. Chand Publishing.

SEMESTER	CODE	SUBJECT	L	T	P	C
I		ESSENTIALS OF COMPUTER SCIENCE AND ENGINEERING	3	0	0	3

(Common to all Branches)

AIM:

The aim is to introduce the fundamentals of Computer to the students

OBJECTIVES:

- To provide basic knowledge on hardware and software components of computers.
- To introduce and demonstrate various software applications
- To introduce Problem solving methodologies
- To learn about Implementation of Algorithms
- To learn about HTML

OUTCOMES:

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

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.

UNIT I - Basics of Computer and Information Technology 10

Computer – Generations, Types of Computers, Block diagram of a computer- Components of a computer system - Hardware and software definitions - Categories of software – Booting - Installing and Uninstalling a Software - Software piracy - Software terminologies - Applications of Computer - Role of Information Technology - History of Internet - Internet Services.

UNIT II - Software Applications (Practical Learning) 7

Office Automation: Application Packages - Word processing (MS Word) - Spread sheet (MS Excel) – Presentation (MS PowerPoint).

UNIT III - Problem Solving Methodologies 10

Problems Solving Techniques - Program Development Cycle – Algorithm Development - Flow chart generation – Programming Constructs (Sequential, Decision-Making, Iteration) - Types and generation of programming languages

UNIT IV Implementation of Algorithms 9

Implementation of Algorithms-program verification-The efficiency of algorithms-The analysis of algorithms-Fundamental Algorithms

UNIT V HTML 9

Basics of HTML – Applications of HTML – HTML Fonts – anchor tag and its attributes – Using images in HTML programs – list tag - Table tag – HTML forms

TOTAL HOURS: 45

TEXT BOOKS

Essentials of Computer Science and Engineering – by VMU

YEAR	I	BIOCHEMISTRY - I	L	T	P	C
SEMESTER	I		3	1	0	4

AIM:

The aim is to provide the students a sound but crisp knowledge on the biochemical basis of life processes and biotechnology.

OBJECTIVES:

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

- Demonstrate his/her knowledge and understanding of the Units, chemical bonding, Structure, function and interrelationship of biomolecules
- Recognize the basic structure of biological molecules and be able to identify their functional groups
- Recognize the basic structure of carbohydrates and lipids, understand their roles in molecular and cellular structure and function
- Understand the basic architecture structure and properties of proteins and nucleic acids.
- Know about the importance of vitamins and minerals and their deficiency disorder.

OUTCOMES

The overall goal of this course is for the student

- Basic cellular structure the special properties of water and how the aqueous environment influences the behavior of biological macromolecules the structures of amino acids, their chemical properties and their organization into polypeptides and proteins. methods for isolating and characterizing proteins
- The basic elements of protein structure, key principles of protein function.enzymes and how they catalyze reactions as well as enzyme kinetics
- Structure of fundamental monosaccharides and polysaccharides
- Structure and basic function of nucleotides
- Structure of different classes of lipids and their roles in biological systems

UNIT: I Measurement and Chemical bonding **9**

SI Units – International System of Units – Basic Units, Derived Units. subsidiary units – Non SI units and their SI equivalents. Ionicbond-energetics, Covalentbond-Valencebond theory. Hybridization-example; methane,ammonia,water, ethane and ethylene. Sigma and pi bond. Molecular orbit theory. Properties of covalent molecules bond length, bond angle and coordinate bond. Van der walls forces, Hydrogen bonds, Inter and intra molecular type, hydrophobic forces.

UNIT: II Carbohydrates and Lipids **9**

Biological importance; Classification and Properties of Monosaccharides, Disaccharides and Polysaccharides(Starch, Glycogen, Cellulose and their derivatives, Chitin, Peptidoglycans, Glycoaminoglycans, Glycoconjugates).

Biological importance, Classification. Fattyacids: classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, Triacylglycerols: nomenclature, physical properties, chemical properties .Glycerophospholipids (lecithins, cephalins. phosphatidyl serine, phosphatidyl inositol, sphingomyelins).

UNIT: III Amino acids and Proteins **9**

Amino acids - Classification, Structure, Properties and Biological importance. Proteins - Classification, Structural organization of Proteins - Primary, Secondary(α-helix, β-pleated structure, triple helix), Tertiary and Quaternary (Myoglobin and Hemoglobin), Factors stabilizing, Properties and Biological importance, Denaturation and Renaturation.

UNIT: IV Nucleic acids **8**

Nucleosides and nucleotides, configuration and conformation, Composition of RNA and DNA, Physico chemical properties of nucleic acids effect of alkali, acid and heat (denaturation and renaturation), features of phosphodiester bond, endonucleases. Complementary base pairing, secondary structure of RNA, features of DNA double helix (WatsonCrick model), Nucleoproteins – histone and nonhistone.

UNIT:V Vitamins and minerals **10**

Nutritional importance of vitamin, classification, source, daily requirements and functions, Deficiency symptoms hypervitaminosis of fat soluble vitamins. Nutritional importance of Minerals, classification, source, daily requirement and deficiency symptoms.

Total: 45 Hours

TEXT BOOKS:

1. Fundamentals of Biochemistry by Jain, J.L., Sunjay Jain and Nitin Jain, 2005. S.Chand & Company Ltd., 6th Edition.

REFERENCE BOOKS:

1. Text Book of Biochemistry for Medical Students by Ambika Shanmugham. Lippin cott Williams & Wilkins, 7th Edn. 2012.
2. Biochemistry by Rastogi S.C. Mc. Graw-Hill Publishing Company Ltd, 6th Edn. 2007.
3. Principles of Biochemistry by David L. Nelson and Michael M. Cox, 4th Edn. W. H. Freeman and Company, 2005.
4. Text book of Biochemistry by Sathyanarayana, U. and Chakrapani, U., 2006, 3rd Edn., Uppala Author Publishers Interlinks.

SEMESTER	CODE	SUBJECT	L	T	P	C
I		PHYSICS LAB (REAL & VIRUTAL)	0	0	4	2

(Common to all branches of B. E.)

AIM

To understand the experiments through online virtual demonstration followed by real hands-on experience.

OBJECTIVE

- To understand the working principle of various physics equipments
- To learn about taking reading precisely
- To know about the systematic handling of equipments

OUTCOME

Students will have the knowledge of taking measurements precisely.

1. Young's modulus of a bar - Non-uniform bending

2. Rigidity modulus of a wire - Torsional Pendulum

3. Viscosity of a liquid - Poiseuille's method

4. Velocity of ultrasonic waves in liquids - Ultrasonic Interferometer

5. Particle size determination using Laser

6. Wavelength of spectral lines – grating - Spectrometer

7. Thickness of a wire - Air wedge Method

8. Thermal conductivity of a bad conductor - Lee's disc

9. Band gap determination of a thermistor - Post Office Box

10. Specific resistance of a wire – Potentiometer

SEMESTER	CODE	SUBJECT	L	T	P	C
I		COMPUTER LAB	0	0	4	2

(Common to all Branches)

OUTCOMES:

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

- Apply good programming design methods for program development

1. Implement Mail Merge in MS-Word and send letters to parents regarding the semester fee structure of the student.
2. Using MS-Word, create a leave letter addressed to your faculty advisor
3. A) Using MS-Word, create a table for a list of students with different font sizes and colours

   B) Using MS-Word, create a flow-chart using the basic shapes available. Use page border, a watermark, header and footer
4. Using MS-PowerPoint, create a presentation about the university
5. Using MS-PowerPoint, create a story line with various animations and transition effects.
6. Using MS-Excel, Analyze Students performance using MS-Excel and prepare a chart type report.
7. Using MS-Excel, create a pivot table
8. Using MS-Excel, create look-up tables
9. Using MS-Excel, create graphs for the weather condition in various cities of India
10. Create an HTML page Create an HTML page to
    a) Click on a link and go to the bottom of the page using <a href>
    b) Display an image.
11. Create an HTML page to
    a) Display ordered and unordered lists of your friends names and sports persons

Display a table with 3 columns and 4 rows.

YEAR	I	BIOCHEMISTRY LAB - I	L	T	P	C
SEMESTER	I		0	0	4	2

AIM:

To develop the skills of the students by providing hand on training in various techniques in Biochemistry.

OBJECTIVES:

At the end of the course, the students would have developed their skills in

- Titrimetric Experiments
- Biochemical preparations
- Analysis of food

OUTCOMES

- The Biochemistry Laboratory is designed to give handson experience with laboratory techniques used in Biochemistry

I. TITRIMETRIC EXPERIMENTS:

a. Estimation of Ascorbic acid by Titrimetric method using 2,6 Dichloro phenol indophenols.
b. Determination of Saponification value of Edible oil
c. Determination of Acid no of Edible oil.
d. Determination of Iodine value of Oil.

II. BIOCHEMICAL PREPARATIONS:

a. Isolation of Chloroplast from Spinach leaves.
b. Cheese Production from Milk
c. Casein from Milk
d. Starch from Potato

III. FOOD ANALYSIS

a. Determination of Moisture content
b. Determination of Ash content
c. Estimation of Calcium content
d. Estimation of Organic Phosphorus content

REFERENCE

SEMESTER	CODE	SUBJECT	L	T	P	C
II		BUSINESS ENGLISH	3	0	0	3

(For I year B.E., all branches)

OBJECTIVES:

- To impart and enhance corporate Communication
- To enable learners to develop presentation skills.
- To build confidence in learners to use English in Business contexts.

OUTCOMES:

- It is hoped that this syllabus will able to communicate with a range of formal and informal context.
- This syllabus will enable the students to undergo in activities, demonstrating interaction skills and consider how own communication is adjusted in different scenario.

UNIT – I **9**

Subject and verb agreement (Concord) – Preposition and Relative Pronoun – Cause and effect- Phrasal Verbs – Idioms and Phrases – Listening comprehension - Listening to Audio Files and Answering Questions – Framing Questions – Negotiation skills, Persuasion Skills and Debating skills.

UNIT – II **9**

Stress (Word stress and Sentence stress) – Intonation – Difference between British and American English– Vocabulary – Indianism - Compound Words(including technical terminology).

UNIT – III **9**

Reading Skills – Understanding ideas and making inferences – Group Discussion – Types of Interviews, FAQs – e- mail Netiquette, Sample e-mails – Watching Documentary Films and responding to questions.

UNIT – IV **9**

Corporate communication – Recommendation - Instruction – Check List- circulars- Inter office memo – Minutes of meeting and Writing agenda – Discourse Markers-

Rearranging the jumbled sentences – Technical Articles – Project Proposals, Making Presentations on given topics – Preparing Power Point Presentations.

UNIT – V **9**

Critical Reading – Book Review - Finding Key Information and Sifting Facts from Opinions – Business letters (Calling for Quotation, Placing orders and Complaint letters) – Expansion of an Idea. – Creative Writing.

Total: 45 hours

REFERENCE BOOKS

1. Grammar Builder- I, II, III -Cambridge University Press.
2. Technical English-Writing, Reading and Speaking- Pickett and Lester, Harper and Row publication

SEMESTER	CODE	SUBJECT	L	T	P	C
II		PROFESSIONAL ETHICS AND HUMAN VALUES	4	0	0	3

OBJECTIVE*:* To create an awareness on Ethics and Human Values in engineering professions and to inspire moral and social values and Loyalty to appreciate the rights of others

OUTCOME: After completing the course the learner should know how to maintain code of conduct in work places and respect to each other.

Unit – I: HUMAN VALUES 9

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

Unit – II: ENGINEERING ETHICS **9**

Senses of Engineering Ethics - variety of moral issues - types of inquiry – moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

Unit – III: ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

Unit – IV: SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining – confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Unit – V: GLOBAL ISSUES **9**

Multinational corporations - Environmental ethics - computer ethics – weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

Total Hours 45

TEXT BOOK

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint).

2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics: Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)

3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

5. Naagarazan. R. S, A Textbook on Professional Ethics and Human Values , New Age Publications.

YEAR	I	BIOCHEMISTRY- II	L	T	P	C
SEMESTER	II		3	0	0	3

AIM:

To study the metabolic pathways and their significance in Biochemistry which will be a prerequisite for the courses offered in the subsequent semesters.

OBJECTIVES:

At the end of the course, the students would have learnt about

- Metabolism of carbohydrates, lipids, amino acids and nucleic acids.
- Metabolic disorders.
- Bioenergetics.

OUTCOMES:

Students will attain knowledge and comprehension of biochemistry

- Students will communicate effectively by expressing ideas and actively listening to the ideas of others during discussions
- Students will think critically by reading biochemistry articles with comprehension, evaluate
- and analyze arguments/data, recognize and form interpretations and generalizations of biochemistry
- Students will utilize writing techniques to learn and develop ideas of biochemical characteristics of components related to biochemistry

UNIT: I Metabolism of carbohydrates and lipids **9**

Carbohydrate metabolism – Glycolysis, TCA cycle, Gluconeogenesis, HMP shunt, Glycogenesis, Glycogenolysis.

Lipid metabolism – Synthesis of fatty acids, Oxidation of fatty acids – α, β, ω, Ketogenesis, Cholesterol, Triglycerides, Phospholipids.

Regulation of carbohydrates and lipid metabolism.

UNIT: II Metabolism of amino acid and nucleic acid **9**

Synthesis and degradation of Arginine, Serine, Glycine, Aromatic aminoacids (Phenylalanine, Tyrosine, Tryptophan), Histidine, Glutamate. Nitrogen fixation, Urea cycle.

Transamination, Deamination, Decarboxylation.

Important molecules derived from amino acids (Auxins, DOPA, Serotonin, Porphyrins, T3, T4, Adrenaline, Nonadrenaline, Histamine, GABA, Polyamines, etc.)

UNIT: III Metabolism of nucleic acid **9**

Biosynthesis of purine and pyrimidine neucleotides – de novo and salvage pathway of purine and pyrimidine metabolism. Details on committed steps in the metabolic pathway. Degradation of nucleotides.

UNIT: IV Bioenergetics and oxidative metabolism **9**

Thermodynamic relationships and high energy compounds, Electron transport chain – Components, Mechanism, Inhibitors, Oxidative phosphorylation – Site of reaction, ATP synthase, Mechanism, Inhibitors, Ionophores, Uncouplers.

UNIT: V Clinical biochemistry **9**

Metabolic disorders: Carbohydrate disorder - Glycogen storage diseases, Diabetes mellitus. Lipid disorder - Niemann Pick disease, Gaucher's disease, Fabrys disease, Tay-sach's disease. Amino acid disorder - Alkaptonuria, Albinism, Phenylketonuria, Gout, Cystinuria. Nucleic acid disorder - Xanthinuria, Orotic acidiuria, Leasch-Nyhan syndrome, Nucleoside Phosphorylase deficiency. Important Diseases – Atheroscelerosis, Parkinson's disease, Alzheimer's disease.

Total: 45 Hours

TEXT BOOKS

1. Jain, J. L., Sunjay Jain and Nitin Jain, 2005. Fundamentals of Biochemistry. *S. Chand & Company Ltd*., 6th Edn.

REFERENCE BOOKS:

1. David L. Nelson and Michael M. Cox, 2005. Lehninger Principles of Biochemistry. *W. H. Freeman and Company, New York,* 4th Edn.
2. Murray, R.K, Granner, B.K, Mayes, P.A, Rodwell, V.W., 2003. Harper's Illustrated Biochemistry.*McGraw-Hill India,* 26th Edn.
3. Voet, D., Voet, G., Pratt, C.W., 2006. Fundamentals of Biochemistry. *John Wiley & Sons (Asia),* 6th Edn.
4. Devlin M. Thomas, 2006. Textbook of Biochemistry with Clinical Correlations. *Wiley-Liss, NJ.* 6th Edn.
5. Jeremy M. Berg, John L. tymoczko and Lubert Stryer, 2007. Biochemistry. *W. H. Freeman and Company, New York,* 5th Edn.
6. Mathew, Van Holde and Athern, 2000. Biochemistry. *Pearson Publishers Ltd*

YEAR	I	BIO-STATISTICS	L	T	P	C
SEMESTER	II	**Common to BE** Bio.Tech and BIF Second Semester	3	1	0	4

Objectives

- Biological study needs collection of data in the lab and classification of the same. Then depict pictorially and interpret.
- For the purpose of studying a population one cannot go for complete enumeration. Hence sampling techniques are to be learnt.
- To understand the data collected we need to do some calculation of statistical constants. For comparison of populations we need tests of significance.
- Large population generally follow normal distribution and hence essential to deal with Biological data as well.
- To correlate more than two variables, one needs multiple and partial correlations and suitable interpretation.

Outcome

- Relate their subject knowledge in techniques, methodology and statistics with their engineering subjects during the course of study
- Understand and apply basic techniques in descriptive statistics.
- Analyze and interpret data.
- Apply statistics in biological field.

Unit 1. Introduction to Biostatistics **9**

Statistics – Definition, Scope, Limitation.- Collection of data - Primary & Secondary Data; Classification & Tabulation of data - Type of Classification & Tabulation - Difference between Classification & Tabulation, Types of Bar Diagrams, Frequency polygon,Histogram,Pie Diagram.

Unit 2. Sampling **9**

Sampling: - Method of Sampling – Random and Non–Random Sampling – Merits and Demerits, Limitation of sampling. Measures of central tendency –Geometric mean, Measures of Dispersion – Range, Quartile deviation, Mean Deviation and their Coefficients.

Unit 3. Curve fitting **9**

Curve fitting by method of least squares and method of moments-Fitting of a straight line,a parabola and Curves of the form $y=(a)e^{bx}$,$y=(a)b^{x}$,$y=(a)x^{b}$.

Unit 4. Multiple and partial correlation **9**

Notations-Equation of regression plane (Three variables)-Multiple correlation coefficients-Partial Correlation coefficients.

Unit 5. Normal Distribution **9**

Normal Distribution –Properties-Problems using area under normal curve –Testing of Hypothesis based on normal distribution-Single mean, Proportion, Standard deviation-Difference between two means, Proportions, Standard Deviations.

Tutorial : 15

Total Hours : 60

Credits : 04

Text Book:

1. S.P. Gupta,"Statistical Methods", Sultan Chand & Sons Publishers.

References:

1. Milton.J.S, "Statistical Methods in Biological & Health Science", M.C. Graw Hill
2. P.N.Arora, P.K.Malhan, "Biostatistics", Himalaya Publishing House.
3. S.S.Sundar Rao, J.Richard, "An Introduction to Biostatistics: A Manual for student in health sciences", Prentice – Hall of India Private Limitted.
4. T.Veerarajan "Numerical Methods" - Tata McGraw-Hill, New Delhi.

YEAR	I	BIOINSTRUMENTATION	L	T	P	C
SEMESTER	II		3	1	0	4

AIM

To have a wide knowledge about the different techniques used for isolation, identification and detection of Bimolecules.

OBJECTIVES

- To study in detail about the Molecular spectroscopy
- To impart knowledge on the principles, instrumentation and applications of all Chromatographic techniques involved in purification.
- To know the qualitative analysis of Protein by various electrophoretic techniques and to have a wide knowledge about the DNA analysis.
- . To study the various Immunotechniques and analysis of Bioprocess.

OUTCOMES

This course will explore both theoretical and practical concepts of bioinstrumentation and its application in a variety of medical and scientific disciplines

UNIT-I

BASICS OF BIOINSTRUMENT 9

Classification and calibration of instrumental methods, Principles and Instrumentation of pH meter & Electronic balance, Gel documentation system, Turbidimetric and Nephelometric titrations.

UNIT - II

SPECTROSCOPY 9

General design and components of spectroscopy ,Principles , Instrumentation and applications of colorimetry, UV – Visible – IR- Raman spectroscopy –NMR spectroscopy, Auger electron and Atomic absorption spectroscopy(AAS)

UNIT-III 9

SEPARATION AND PURIFICATION TECHNIQUES:

Principles and Instrumentation of centrifugation, Paper and column chromatography, Ion exchange, Size exclusion, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas chromatography , Electrophoresis of Nucleic acid and protein.

UNIT- IV **8**

THERMAL AND X-RAY METHODS

Thermo-gravimetric methods, Differential thermal analysis, Differential scanningcalorimetry.

X-ray sources, absorption of X-rays, X-ray diffraction, X-ray detectors.

UNIT -V **10**

IMMUNOTECHNIQUES AND ANALYSIS OF BIOPROCESS

Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Location of cells in tissues, Immunoblotting, Analysis of biomass, Measurement of BOD and COD in waste waters, Gas analysis for O_2 and CO_2, Flow injection analysis.

Total : 45 Hours

TEXT BOOKS:

1. Chatwal and Anand, 2006. Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
2. Upadhyay, Upadhyay and Nath. Himalaya Publishing House. Biophysical Chemistry (Principles & Technology., 2009.
3. Skoog, D., 2000. Instrumental Methods of Analysis, David Hariss, 5th Edition.
4. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods of Analysis. *CBS Publishers and Distributors*.

REFERENCES:

1. Dinesh Kumar Chatanta and Prahlad Singh Mehra, 2012. Instrumental Methods of Analysis in Biotechnology. I K International Publishing House.
2. Hobart H. Willard, Lynne L. Merrit, John, A. and Frank A. Settle, 1981. Instrumental Methods of Analysis. *Van Nostrand*.
3. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, *Benjamin Cummins and Company*.
4. Sewell, P.A. and Clarke, B., 1991. Chromatographic Separations. *John Wiley and Sons*

5. Ewing, G.W., 1989. Instrumental Methods of Chemical Analysis. *McGraw Hill Book Company*

SEMESTER	CODE	SUBJECT	L	T	P	C
II		C PROGRAMMING	3	0	0	3

(Common to all branches of B.E./B.Tech. students for 2012-2013 batch)

AIM:

The aim is to introduce C programming to the students.

OBJECTIVES:

- To introduce Basics of C
- To understand Control Structures & Arrays
- To learn about String concept, Structure and Union in C
- To introduce the concepts of Functions and Pointers
- To introduce Memory and File management concepts in C

OUTCOMES:

- Design and implement C programs for simple applications.
- Develop recursive programs

UNIT I - Basics of C **9**

Identifiers, variables, expression, keywords, data types, constants, scope of variables. Operators: arithmetic, logical, relational, conditional and bitwise operators - Special operators: size of () & comma (,) operator - Precedence and associatively of operators - Type conversion in expressions.

UNIT II - Control Structures & Arrays **9**

Basic input/output and library functions: Single character input/output i.e. getch(), getchar(), getche(), putchar() - Formatted input/output: printf() and scanf() – Library functions (mathematical and character functions). Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and two dimensional arrays.

UNIT III String, Structure & Union **9**

Strings: Declaration-Initialization and string handling functions. Structure and Union: structure declaration and definition – Accessing a Structure variable – Structure within a structure – Union.

UNIT IV Functions and Pointers **9**

Function –Function Declaration–function definition- Pass by value – Pass by reference – Recursive function – Pointers - Definition – Initialization – & and * operators - Pointer to functions-Function returning pointers – Pointers and arrays

UNIT V Memory and File management **9**

Static and dynamic memory allocation - Storage class specifier - Preprocessor directives. File handling concepts – File read – write- Functions for file manipulation: fopen, fclose, gets, puts, fprintf, fscan, getw, putw, fputs, fgets, fread, fwrite - Random access to files: fseek, ftell, rewind - File name as Command Line Argument.

TOTAL HOURS: 45

TEXT BOOKS:

1. Balaguruswami.E, “Programming in C”, TMH Publications,1997

REFERENCE BOOKS:

1. Behrouz A. Forouzan & Richard F. Gilberg, “Computer Science A Structured Programming using C”, Cengage Learning, 3rd Edition, 2007

2. Gottfried , “Programming with C”, schaums outline series, TMH publications,1997

3. Mahapatra , “Thinking in C”, PHI publications, 2nd Edition, 1998.

4. Subbura.R , “Programming in C”, Vikas publishing, 1st Edition, 2000

YEAR	I	BIOCHEMISTRY- II LAB	L	T	P	C
SEMESTER	II		0	0	4	2

AIM:

To explore the investigations in Biochemistry.

OBJECTIVES:

At the end of this laboratory course, the student would have learnt about the Principle/mechanisms, procedures and various techniques performed during biochemical Analysis.

OUTCOMES

- The Biochemistry Laboratory is designed to give handson experience with laboratory techniques used in Biochemistry

1. Qualitative Analysis of Carbohydrates.
2. Qualitative Analysis of Amino acids.
3. Qualitative Analysis of Lipids.
4. Qualitatively analysis of Normal and abnormal constituents of Urine
5. Estimation of Glucose by O-toludine method.
6. Protein estimation by Biuret, Lowry's, Bradford methods.
7. Estimation of Cholesterol by Zak's method.
8. Estimation of urea DAM method.
9. Estimation of ESR and PCV.
10. Estimation of Hemoglobin.
11. Extraction, separation and determination of absorption spectra of plant pigments (Demo)
12. Separation of plant pigments by column chromatography (Demo).

REFERENCES:

1. Laboratory Manual.

YEAR	I	BIOINSTRUMENTATION LAB	L	T	P	C
SEMESTER	II		0	0	4	2

AIM

To make the students conversant in handling and understanding number of principles behind various instruments.

OBJECTIVES

 To understand the concepts of instrumentation used to measure factors that characterize biological systems and physical or chemical factors that have a profound effect on biological entities.

- To demonstrate the proper operation, maintenance and applications of common analytical laboratory instruments, including equipment for electrophoresis, spectrophotometry, and chromatography.
- To properly apply scientific mathematical skills to calculations relevant to the laboratory.
- To demonstrate qualitative and quantitative analytical skills with various common instruments using common biotechnology laboratory protocols.
- To develop critical thinking skills relevant to biotechnology rough data analysis, troubleshooting experiments and equipment, suggesting continuous improvements.

OUTCOMES

- The competency outcomes for this course reflect skills necessary in the biotechnology workforce and also to understand about qualitative and quantitative analytical skills with various common instruments using common biotechnology laboratory protocols.

1. Validating Lambert – Beer's law using $KMnO_4$.
2. Determination of complementary color and complementary wavelength
3. Precision and Validity in an experiment using Absorption spectroscopy.
4. Finding the Stoichiometry of the Fe (1,10 Phenanthroline Complex) using Absorption spectroscopy.
5. UV spectra of Nucleic Acid.
6. Estimation of Alizarin Aluminium complex
7. Estimation of Al^{3+} concentration using Alizarin in the spectrometer.
8. Estimation of Sulphate by Nephelometry.
9. Experiments on
    a. Conductivity meter
    b. Turbidity meter.
10. Estimation of Dissolved oxygen.

11. Determination of Fe^{2+} content in fruit juices

REFERENCES

1. Laboratory Manual.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		C PROGRAMMING LAB	0	0	4	2

(COMMON TO CSE, IT, CSSE, M.Sc, MECH, AUTO, AERO, CIVIL, BIO-TECH, BIO-INFO)

OUTCOMES:

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

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

1. Write a C Program to Implementation of Sine and cosine series
2. Write a C Program to calculate Simple Interest
3. Write a C Program to generate Fibonacci Series using for loop
4. Write a C program to calculate factorial using while loop
5. Write a C Program to
   a) Find the greatest of three numbers using if condition.
   b) Find the greatest of three numbers using conditional operator.
6. Write a C program for finding the roots of a given quadratic equation using conditional control statements
7. Write a C program to
   a) Compute matrix multiplication using the concept of arrays.
   b) Illustrate the concept of string handling functions.
8. Write a C program to
   a) Find the largest element in an array using pointers.
   b) Convert a binary number to decimal or decimal to binary using functions.
9. Write a C program to read data from keyboard, write it to a file named student again read the same data from student file and write it into data file.
10. Write a C program to store employee details using the concept of structures.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		YOGA AND MEDITATION LAB	0	0	4	2

SEMESTER III

YEAR	II	CELL BIOLOGY	L	T	P	C
SEMESTER	III		3	1	0	4

AIM

The course aims to develop skills of the students in the area of Cell biology and cell signalling pathways. This will be a prerequisite for courses like Molecular biology.

OBJECTIVES

At the end of the course, the students would have gained in-depth knowledge on

- Nuances and working of the cell
- Functions of the organelles.
- Cell membrane and permeability.
- Cell signalling molecules.
- Signal transduction.
- Cell culture.

OUTCOMES

- The course should provide knowledge of the basic structures and cell biology-related mechanisms in an eukaryote cell.
- It provide basic genetic terminology at a general level and describe the organisation and development of the genetic makeup on cellular, chromosomal and gene level and be able to explain the basic molecular genetic mechanisms in relation to the structure and function of the cells.

UNIT I **9**

CELL AND FUNCTIONS OF THE ORGANELLES

General structure – Prokaryotic and eukaryotic cell, Molecular organization of the cell membrane, Cell membrane – Proteins, Lipids and Carbohydrates, Cell organelles, Cytoskeletal proteins, Types of cell functions, Mitosis and meiosis, Cell cycle.

UNIT II **9**

CELL MEMBRANE AND PERMEABILITY

Passive and active transport, Permeases, Sodium potassium pump, Ca^{2+}, AT Pase pumps, Lysosomal and vacuolar membrane, Co-transport, Uniport, Symport, Antiport, Protein localization & Membrane trafficking,, Endocytosis and exocytosis, Entry of viruses and toxins into cells.

UNIT III **8**

CELL SIGNALLING MOLECULES AND THEIR RECEPTORS

Cytosolic, Nuclear and membrane bound receptors, Examples of receptors, Modes of cell - cell signalling – Autocrine, Paracrine and Endocrine models of action, Secondary messengers molecules, Quantitation and characterization of receptors.

UNIT IV **10**

PATHWAYS AND INTRACELLULAR SIGNAL TRANSDUCTION

Signal amplification – Different models of signal amplifications, Cyclic AMP, Role of inositol phosphates as messengers, Biosynthesis of inositol triphosphates, Cyclic GMP and G proteins role in signal transduction, Calcium ion flux and its role in cell Signalling, Current models of signal amplification, Phosphorylation of protein kinases.

UNIT V **9**

CELL CULTURE

Techniques for the propagation of prokaryotic and eukaryotic cells, Cell line, Generation of cell lines, Maintenance of stock cells, Characterization of cell, Morphological analysis techniques in cell culture, Explant cultures, Primary cultures, Contamination, Differentiation.

Tutorial: 15 **Total : 60 Hours**

TEXT BOOKS

1. De Robertis E.D.P and De Robertis E.M.F. 2001. Cell and Molecular Biology. 8th Edn., Lippincott Williams & Wilkins, New York, USA.
2. Darnell J. Lodish, Baltimore, H. and Freeman, D., 2005. Molecular Cell Biology (5th Edition). *W. H. Freeman and Company.* James D. Watson. 1994.

REFERENCES

1. B Alberts, A Johnson, J Lewis, M Raff, K Roberts, P Walter 2002. Molecular Biology of the Cell (4th Edition) New York: Garland Science.
2. Kimball, T.W., 1989. Cell Biology. *Addision Wesley Publishers*.
3. Geoffrey M. Cooper and Robert E. Hansman, 2007. The Cell : A Molecular Approach, 4th Edn., *ASM Press and Sinauer Associates Inc.*,USA.
4. Ian Freshney, R, 2005. Culture of Animal Cells. 4th Edn., *Alan R. Liss Inc.*, New York.

YEAR	II	MICROBIOLOGY	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

To know the fundamentals of Microbiology by studying the Characteristic structural organisation and replication of microor-ganisms, Microscopy, Microbial nutrition, Role of microbes in food, clinical and ecological importance of microbes and their control.

OBJECTIVES

- To have knowledge about the World of microorganisms and microscopy.
- To study the Structure and replication concepts in microorganisms.
- To know the requirements of Microbial nutrition for growth of microorganisms and the impact of environment on its growth.
- To understand the effects of Microbes in food and the clinical importance of microorganisms.
- To evaluate the Control of microorganisms and its environmen-tal applications.

OUTCOMES

- Understand the controlling of microbes using physical and chemical methods .
- Acquire knowledge about industrial and environmental microbial applications.
- Recognize the fundamental concepts in the structure and functioning of a cell.
- Demonstrate the microbial nutritional requirements for growth and metabolism.
- Comprehend knowledge about historical perspective of microbiology and its developments.

UNIT I **9**

WORLD OF MICRORGANISMS AND MICROSCOPY

Historical review of the foundation of microbiology, Characteristics of microorganisms, Taxonomy methods of studying microorganisms, Microscopy - Light, Electron, Micrometry.

UNIT II **8**

STRUCTURAL ORGANISATION OF MICROORGANISMS

General structural and cellular organization of Bacteria, virus, fungi, algae and protozoa.

UNIT III **8**

MICROBIAL GROWTH AND NUTRITION

Nutritional requirements, Growth of microorganisms, Aerobic and anaerobic growth, Different methods of microbial enumeration, Methods of preservation of microbes. Effects of physical, chemical and environmental factors on microbial growth.

UNIT IV **10**

FOOD AND CLINICAL MICROBIOLOGY

Food spoilage and poisoning, , Clinically important microorganisms and their effects on infections, Formation of toxic materials by microorganisms and their role in clinical microbiology.

UNIT V **10**

CONTROL OF MICROORGANISMS AND ITS ENVIRONMENTAL APPLICATIONS

Pollution control through use of microorganisms, Recycling of biomaterials, Production of biogas, Leaching of ores by microorganisms, Microbial indicators, Biofouling.

Total : 45 Hours

TEXT BOOKS

1. Pelzar, M.J., Chan, E.C.S and Krieg, N.R. 1993.Microbiology. Tata McGraw Hill Edition. New Delhi. India.

2. Ananthanarayan and Jayaram Paniker, 1999. Text Book of Microbiology. Orient Longman Publishers.

REFERENCES

1. Talaro, K., Talaro A. Cassida Pelza and Reid, 1993. Founda-tion in Microbiology. W.C. Brown Publishers.

2. Prescott, Harley and Klen, 2003. Microbiology. McGraw Hill Publications. 5th Edn.

3. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York.

4. George, J.B., 1987. Basic Food Microbiology. CBS Publish-ers and Distributors.

5. James, M.J., 1987. Modern Food Microbiology. CBS Pub-lishers and Distributors.

YEAR	II	CLASSICAL AND MOLECULAR GENETICS	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

The course is aimed to make the student knowledgeable about the basic concepts of Genetics and to emphasize the role of genetics in modern biology.

OBJECTIVES

- To understand the basic concepts of Classical, Molecular Genetics through Mendelian experiment and fine structure of Genes.
- To study the Structural organisation of chromosome.
- To help students understand sex determination mechanisms and Genetic disorders with reference to alleles.
- To impart knowledge on Linkage and crossing over.
- To learn the mechanism of Microbe mediated Genetic transfer.

OUTCOMES

Understand and explain the logic and core concepts of classical and molecular genetics, including: prediction of genotypic and phenotypic ratios for complex crosses; mechanisms of DNA replication, recombination, transcriptionand translation,and how mutations can alter the outcomes of these processes; mitosis and meiosis; gene mapping; gene expression; genetic engineering and genomics

.

UNIT I **9**

BASICS OF GENETICS & GENES

Classical genetics, Mendelian laws, Mendel's experiment monohybrid and dihybrid inheritance, Fine structure of genes, Gene as the unit of expression, Control sequences - promoter, operator, terminator and attenuator.

UNIT II **9**

KARYOLOGY

Chromosome structure and organisation in prokaryotes and eukaryotes, Extra chromosomes and their inheritance, Biology of plasmids, Giant chromosomes – Polytene and Lampbrush chromosome.

UNIT III **9**

ALLELES

Classical concept of allelomorphism, Multiple alleles, Sex linkage in Drosophila, Sex determination in Human beings, Sex linkage in Human beings, Colour blindness, Haemophilia, Blood group antigens.

UNIT IV **9**

LINKAGE AND CROSSING OVER

Coupling and repulsion – Hypothesis, Test cross in maize and Crossing over, Sex chromosomes, Sex linked inherited disorders, Linkage, Crossing over and Genetic mapping of chromosomes.

UNIT V **9**

MICROBIAL GENETIC TRANSFER

Identification of the genetic material – Classical experiments, Hershey Chase, Avery McLeod etc., Conjugation, Transduction and Transformation, Transposons- mechanism.

Total : 45 Hours

TEXT BOOKS

1. Verma, P.S. and Agarwal, V.K., 2005. Genetics. *S. Chand Publication*.
2. Robert H. Tamarin, 2002, Principles of Genetics, 7th Edition, Tata McGraw Hill, New Delhi.

REFERENCES

1. Goodenough, U., 1985. Genetics. *Hold Saunders International*.
2. Gardner, E.J., Simmons, M.J. and Slustad, D.P., 1991. Principles of Genetics, Blackwell publication, USA.
3. Stanly R. Maloy, John E. Cronan and David Freifelder, Jr., 2006. Microbial Genetics. *Narosa Publishing House.*
4. Brown, T. A. Genetics – A Molecular Approach.
5. Snustad, D. P., 2008. Principles of Genetics. 6th Edn., *John Wiley & Sons*.

YEAR	II	BIOORGANIC CHEMISTRY	L	T	P	C
SEMESTER	III		3	0	0	3

AIM

To deal with the basic considerations of Bio-organic chemistry and the chemistry involved in the Biological systems.

OBJECTIVES

- To know the Basic consideration and proximity effect in Bio-organic chemistry.
- To discuss the Chemistry of amino acids and peptides.
- To study the Chemistry involved in enzymes.
- To impart knowledge on the Enzyme models.
- To enlighten the role of Metal ions which are essential for bio-logical systems.

OUTCOMES

The student should be able to

- Correlate the chemical structure of biomolecules to reactivity
- Use rules for description of the structure and stereochemistry of bioorganic compounds
- Relate the chemical structure of biomolecules to properties such as solubility, binding ability (hydrogen bond ability, lipophilicity, hydrophilicity), chirality
- Discuss similarities and differences between transformations of biomolecules in living systems (aquatic environment) and in vitro, e.g. industrial synthesis
- Describe how some course concepts are applied within the biomolecular - and pharmaceutical sciences.

UNIT I **8**

INTRODUCTION TO BIO-ORGANIC CHEMISTRY

Basic Considerations - Proximity effects in Organic chemistry -Molecular recognition and the supramolecular systems

UNIT II **9**

BIO - ORGANIC CHEMISTRY OF AMINO ACIDS AND PEPTIDES

Chemistry of living cells, Analogy between organic reactions and Biochemical Transformations, Chemistry of the peptide bond, Asymmetric synthesis of amino acids - Retrosynthetic analysis, Transition state analogues.

UNIT III **9**

ENZYME CHEMISTRY

Introduction to catalysis - Mutifunctional, Acid - base and Covalent catalysis, Introduction to enzymes - Chymotrypsin, Pyruvate dehydrogenase, Ribonuclease, Lysozyme, Enzymes in synthetic organic chemistry, Design of molecular clefts.

UNIT IV **9**

ENZYME MODELS

Host guest Complexation chemistry - Cyclodextrin, Development in Crown ether chemistry - Azo Crown ethers and Lariat Crown ethers, Enzyme design using steroid templates -, Co - enzyme chemistry- NAD, NADP, FAD and pyridoxal phosphate.

UNIT V **10**

METAL IONS IN BIOLOGICAL SYSTEMS

Metal ions in proteins and biological molecules - Carboxy peptidase and role of zinc, Hydrolysis of amino acid esters, amides and peptides, Iron and oxygen transport, Biomodels for photosynthesis and energy transfer.

Total: 45 hours

TEXT BOOKS

1. Zubay, G., 1987. Biochemistry. 2nd Edn., Maxwell Macmillan International Editions.

2. Dugas, H., 1989. Bio-organic Chemistry - A Chemical Ap-proach to Enzyme Action. Springer Verlag.

3. David Van Vranken, Gregory A. Weiss., 2012. Introduction to Bioorganic Chemistry and Chemical Biology. (1st Edition) New York: Garland Science.

REFERENCES

1. Mathew, Van Holde and Athern, 2000. Biochemistry. Pearson Publishers Ltd.

2. Page, M. I. and Williams, A., 1997. Organic and bio-organic mechanisms. Pearson India Edition.

3. Ariya, K. and Kumtake T., 2006. Supramolecular chemistry : Fundamentals and applications. Springer India Edition.

4. Palmer, Trevor, 2004. Enzymes : Biochemistry, biotechnology, clinical chemistry. East - West Press Pvt. Ltd.

5. Fersht, Alan, 1998. Structure and Mechanism in Protein Sci-ence : A Guide to Enzyme Catalysis and Protein Folding. W. H. Freeman.

YEAR	II	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
SEMESTER	III		3	0	0	3

UG – FULL TIME AND PART TIME

(COMMON TO ALL BRANCHES OF B.E./B.Tech./BBA/BCA- CBCS Regulations 2015)

OBJECTIVES: To create awareness on the various pollutions and their impact.

To provide comprehensive insight in natural resources.

To educate the ways and means to protect natural resources.

To impart fundamental knowledge on human welfare measures.

OUTCOME:

The students will get the knowledge about environment and they will work their corresponding field with eco friendly. It will protect our environment from pollution

UNIT - I - ENVIRONMENT AND NATURAL RESOURCES 9 hrs

Environment - Definition, scope & importance - Public awareness- Forest resources, mineral resources , water resources, food resources , energy resources (uses, over - exploitation & adverse

effects in each case) - Scope & role of environmental engineers in conservation of natural resources - Sustainability development.

UNIT - II - ECOSYSTEMS AND BIO – DIVERSITY 9 hrs

Ecosystem - Definition, structure and function - Energy flow -Ecological succession - food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest, grassland, desert and Aquatic ecosystems - Bio - Diversity :values and uses, hotspots, threats and conservation.

UNIT - III - ENVIRONMENTAL POLLUTION

Pollution - Definition , man made impacts and control measures of air, water and land pollution - Water quality standards & characterization - Importance of sanitation -Nuclear hazards – Hazardous waste management : Solid waste, waste water and biomedical waste - Prevention of pollution and role of individual – Disasters management : Floods, earthquake, cyclone and land slides - Clean technology options.

UNIT - IV - SOCIAL ISSUES AND ENVIRONMENT **9 hrs**

Urban problems related to energy - Water conservation – Resettlement and rehabilitation of people - Environmental ethics - Climate change - Global warming - Acid rain - Ozone depletion-

Waste land reclamation, Environment Protection Act for air, water, wild life and forests - Pollution Control Board.

UNIT - V - HUMAN POPULATION AND ENVIRONMENT **9 hrs**

Population growth - Population explosion - Family welfare programme - Environment & human health - Human rights – Value education - Women and child welfare, Role of information technology in environment and human health.

Total: 45 hours

TEXT BOOKS

1. Environmental Science and Engineering by Dr. A. Ravikrishnan, Sri Krishna Publications, Chennai.

REFERENCES

1. Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.

2. Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India

3. Trivedi R.K. " Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviro media.

4. Environmental Science and Engineering by Dr. J. Meenambal ,MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson Education PvtLtd., II Edition, ISBN 81-297-0277-0, 2004

5. Miller T.G. Jr Environmental Science Wadsworth Publishing Co.

6. Townsend C. Harper J. and Michael Begon, Essentials of Ecology,Blackwell Science.

YEAR	II	UNIT OPERATIONS IN PROCESS INDUSTRIES	L	T	P	C
SEMESTER	III		3	1	0	4

AIM

To understand the basic concepts of Fluid mechanics, Heat Transfer and Mechanical operations

OBJECTIVES

To have an exposure about the

- Principles and Mechanism of Heat Transfer.
- Fundamentals of Convection and Radiation.
- Principles of Heat Exchanger Design.
- Basic concepts of Fluid Mechanics.
- The theory behind Mechanical Separation and Drying.

OUTCOMES

- The student must demonstrate basic knowledge of the basic operations of chemical engineering.
- The student must demonstrate proficiency in identifying, formulating and solving simple problems in the field of analysis, material balances, basic operations of equilibrium stages and calculating chemical reactors.

UNIT I **9**

CONDUCTION

Modes of Heat Transfer – Heat conduction – Steady state conduction – Heat Conduction through composite wall, Hollow Sphere, Hollow cylinder, Combined Conduction-convection – Extended Surfaces, Critical Thickness of Insulation, individual and Overall Heat transfer Coefficient.

UNIT II **9**

CONVECTION AND RADIATION

Convection – Dimensional Analysis – Forced Convection and Natural convection – Boiling and condensation, Concept of Radiation, Laws of Radiation, Grey & Black Bodies

UNIT III **9**

HEAT EXCHANGER

Heat Exchanger – Types of Heat Exchangers – Types of Flows, LMTD, Fouling Factor, NTU concept, Types of Evaporators – Calculation for Single and Multiple Effects.

UNIT IV **9**

FLUID MECHANICS

Introduction – Nature of Fluids, Properties of Fluids, Types of Fluids, Fluid Statics, Pressure measurement, Measurement of Fluid flow – Venturimeter, orifice meter, rotameter, Fluidization – Mechanism, types and its applications

UNIT V **9**

DRYING AND MECHANICAL SEPARATION

Drying – Air properties – Drying Equipments – Drying Rates and Drying time.

Classification of Mechanical Separation processes, Solid Liquid Separation – Filtration – Constant Pressure, Constant Volume, Batch and Continuous Filtration – Industrial Filter, Centrifugal Separation, Settling and Sedimentation.

Tutorial : 15 **Total : 60 Hours**

TEXT BOOKS

1. Christie J. Geankoplis. Transport Processes and Unit Operations. *Prentice Hall India Pvt. Ltd.,* 3rd Edn. 1993.
2. McCabe, W.L, Smith, J.C and Harriott P. 1993. Unit Operations in Chemical Engineering. *McGraw Hill International Edition.*

REFERENCES

1. Robert E. Treybal. Mass Transfer Operations. 3rd Edn., *McGraw Hill International*.
2. Frank P. Incropera, 1998. Fundamentals of Heat and Mass Transfer and Interactive Heat Transfer. *John Wiley & Sons.*
3. Gavahane. Heat and Mass Transfer. Vol. II.
4. Foust, A. S. Principles of Unit Opeartion. 2nd Edn., *John Wiley & Sons.*
5. Kumar, D. S., 1997. Heat and Mass Transfer. 5th Edn., *S. K. Kataria & Sons*.

YEAR	II	CELL BIOLOGY LAB	L	T	P	C
SEMESTER	**III**		**0**	**0**	**4**	**2**

AIM

The course aim is to offer hands on training in the area of cell culture, cell identification and to demonstrate various techniques to learn the morphology, identification and propagation of cells.

OBJECTIVES

- To demonstrate working principles of microscopy
- To understand the basic techniques to work with cells
- To understand and perform cells staining
- To identify the various stages of mitosis
- To identify the types of blood cells

OUTCOMES

Students in this course will:

- Increasing our knowledge of major cellular concepts from General Cell Biology lecture
- Specific topics include: protein folding and structure, making chemical solutions, lab calculations, lab safety.
- Maintaining a lab notebook and interpreting results through written lab reports.
- Developing scientific graphs, understanding graphs from literature.

1. Introduction to principles of sterilization techniques and cell propagation
2. Principles of Microscopy
3. Isolation of Cell organelle – Mitochondria, Microtubules, Actin and Myosin filaments
4. Cell Fractionation – Separation of peripheral blood mononuclear cells from blood
5. Cell staining - Gram's staining, Leishman staining
6. Cell counting - Tryphan blue assay, Alamar blue assay
7. Osmosis and Tonicity
8. Staining for different stages of mitosis in *Allium cepa* (Onion)

REFERENCES

Laboratory Manual

YEAR	II	MICROBIOLOGY LAB	L	T	P	C
SEMESTER	**III**		**0**	**0**	**4**	**2**

AIM

To give an opportunity of verifying the Theoretical concept by experimentally in a more explicit and concentrated manner.

OBJECTIVES

The students should understand the basic concepts of Microbiology, develop their skills in the preparation, identification and quantification of Microorganisms.

OUTCOMES

- The safe methods for isolation, subculture, and maintenance of bacterial, fungal, and viral specimens
- An understanding of fundamental stains, basic staining techniques, and related bacterial and fungal physiology.
- An understanding of bacterial, fungal, and viral structure and metabolism as it relates to identification and control of pathogenic organisms.
- An understanding of the uses of various media and testing protocols with focus on clinical applications.
- An understanding of the common pathogenic microorganisms and the disease processes they cause.

EXPERIMENTS

1. Sterilization Techniques.
2. Culture Media Preparations
    a. Broth media
    b. Agar
3. Culturing of Micro organisms
    a. Pure Culture techniques -Streak plate
    -Pour plate
4. Isolation, Enumeration and Purification of Microbes from a given sample.
5. Preservation of Bacterial Culture.
6. Identification of Microorganisms
    a. Staining techniques-Simple-Gram-Spore-Hanging drop
    b. Biochemical identification
7. Quantification of Microorganisms
    Microscopy

a. Serial dilution and plating

8. Environmental Sample Analysis-. MPN Test

9. Food Microbiology

-Milk

-Fermented food

10. Clinical Microbiology

- Blood and Urine Culture

- Antibiotic Disc test Assay.

REFERENCES

1.Cappuccino, J. G. and Sherman, N., 1999. Microbiology : A laboratory Manual. 4th Edn., Addison - Wesley.

2.Collee, J. G., et al., 1996. Mackie and McCartney Practical Medical Microbiology. 4th Edn., Churchill Livingstone.

3.Sundararaj, T., 2007. Microbiology laboratory manual. Aswathy Sunndararaj.

4.Laboratory Manual.

YEAR	II	BIO-ORGANIC CHEMISTRY LAB	L	T	P	C
SEMESTER	**III**		**0**	**0**	**4**	**2**

AIM

To verify the Theoretical concepts practically in a more Explicit and Concentrated manner.

OBJECTIVES

The Students should be able to develop their skills in the interconversions of Carbohydrates and Preparation of Amino acids.

OUTCOMES

The students will have hands on experience on the synthesis of certain useful bioorganic molecules and be able to analyse their physical and chemical properties.

1. Synthesis of Aspirin
2. Hydrolysis of Sucrose
3. Preparation of Pyruvic acid from Tartaric acid.
4. Preparation of Oleic acid
5. Preparation of alpha D- glucopyranose pentaacetate
6. Preparation of Lycopene from Tomato paste
7. Preparation of L-Proline.
8. Preparation of 1,2,5,6 di- O-Cyclohexylidine-alpha-D-glucofuranose.
9. Preparation of s-ethyl hydroxybutonate from ethyl acetoacetate using Yeast.
10. Preparation of s-ethyl hydroxybutonate using 3,5 dinitrobenzoate.

REFERENCE

1. Fummis, B. S., Hannaford, A. J. and Smith, P. W. G., 1995. Textbook of Practical Organic Chemistry, Longman Edition.

2. Laboratory Manual.

SEMESTER IV

YEAR	II	MOLECULAR BIOLOGY	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

The course offers the fundamental concepts and basic principles of Structure of DNA, RNA, Transcription, Translation, Gene regulation and Recombinant DNA technology.

OBJECTIVES

- To gain knowledge on Nucleic acids, their characteristics and organization.
- To learn the process of Transcription.
- To understand the principles and mechanism of translation.
- To study the mechanism of Gene regulation and mutations.
- To familiarize with the fundamentals of Recombinant DNA technology.

OUTCOMES

- Identify the principles of DNA replication, transcription and translation and explain how they relate to each other.
- Discuss clearly about gene organization and mechanisms of control the gene expression in various organisms.
- Articulate applications of molecular biology in the modern world.
- Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them.

UNIT I **10**

NUCLEIC ACIDS AND DNA REPLICATION

Introduction to Nucleic acids – Primary, Secondary and Tertiary structures, Structure and physicochemical properties of elements in DNA and RNA, Chemical and structural

qualities of 3',5'-Phosphodiester bond, Chargaff's rule, Replication in prokaryotes and eukaryotes – Different modes of replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Complex replication apparatus, Inhibitors of replication

UNIT II **8**

TRANSCRIPTION

Structure and function of mRNA, rRNA and t RNA,Exon, Intron, Promoters, Enhancers, Transcription factors, Inhibitors, Transcription in prokaryotes and eukaryotes, Post transcriptional modifications, Reverse transcription.

UNIT III **10**

TRANSLATION

Genetic code and its features, Wobble hypothesis and its importance, Colinearity of gene and polypeptide, Structure and functions of ribosomes, Translation mechanism, Post translational modifications, Protein folding.

UNIT IV **9**

REGULATION OF GENE EXPRESSION

Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Regulation of gene expression with reference to λ phage life cycle. Gene regulation – Operons : Lac, trp, ara and gal, .

UNIT V **8**

MUTAGENESIS AND REPAIR

Mutagens, DNA Mutations and their mechanism, various types of DNA repair mechanism.

Total Hours : 45

TEXT BOOKS

1. Freifelder, D., "Molecular Biology", 2nd Edition, Narosa Publishing House, 1999.
2. Benjamin L., "Genes IX" Jones and Bartlett, 2008.
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 2002. Biochemistry. 5th Edn., *W.H. Freeman and Company*.

REFERENCES

1. James Watson *et al.,* 1987. Molecular Biology of Gene. *The Benjamin / Cummings Publication Co. Inc.,* California.
2. Turner, P.C., McLennan, A.G., Bates, A.D. and White, M.R.H., 2003. Instant Notes in Molecular Biology. *Viva Books Private Limited*.

3. Brown, T.A. Gentics – A Molecular Approach.
4. Lodish, Berk, Zipursky, Matsudaira, Baltimore Darnell, 2000. Molecular Cell Biology. 4th Edn., *W.H. Freeman and Company*.
5. Alberts, B. Essential Cell Biology : An introduction to the Molecular Biology of the Cell. *Garland Publishing Inc*.

YEAR	II	ENZYME ENGINEERING AND TECHNOLOGY	L	T	P	C
SEMESTER	IV		3	1	0	4

AIM

The course provides an opportunity to understand the theoretical concepts of Enzyme technology principles in an explicit and concentrated manner.

OBJECTIVES

To impart knowledge on

- Isolation and purification of enzymes.
- Mechanism of enzyme action.
- Enzyme immobilization techniques.
- Immobilized enzyme reactors.
- Applications of enzymes.

OUTCOMES

The students will acquire knowledge in all aspect of Biocatalysis, enzyme kinetics and immobilization. The enzymatic transformation will give theoretical idea about drug biotransformation.

UNIT I **9**

CLASSIFICATION, PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES

Classification of enzymes, Production and purification of crude enzyme extracts from plants, Animals and microbial sources – Case studies (Isolation and purification of lipase from microbial sources), Methods of characterization of enzymes, Overview of enzymatic assays.

UNIT II **10**

MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of enzyme action, Concept of active site and energetics of enzyme substrate complex formation, Specificity of enzyme action, Kinetics of single substrate reactions – Michaelis – Menton kinetics, Determination of $K_{m,}$ Lineweaver – Burk plot, Eadie – Hofstee plot, Hanes – Woolf plot, Multi substrate reaction mechanisms (Ping – Pong, Bi – Bi and Random Bi – Bi).

UNIT III **9**

INHIBITION OF ENZYME ACTIVITY AND ENZYME IMMOBILIZATION

Types of enzyme inhibition – Competitive inhibition, Uncompetitive inhibition, Non-competitive inhibition, Mixed inhibition, Substrate inhibition, Allosteric inhibition, Irreversible inhibition, Physical and chemical techniques for enzyme immobilization – Adsorption, Matrix entrapment, Encapsulation, Cross - linking, Covalent binding etc., Advantages and disadvantages of different immobilization techniques, Application of immobilized enzyme systems.

UNIT IV **8**

IMMOBILIZED ENZYME REACTORS AND DIFFUSIONAL LIMITATIONS

Immobilized enzyme reactors – Packed bed, Fluidized bed, Membrane reactors, Air - lift bioreactors and CSTRs suited for immobilized enzymes. Diffusion effects in surface – bound enzymes on non-porous support materials, Diffusion effects in enzyme immobilized in a porous material.

UNIT V **9**

APPLICATIONS OF ENZYMES

Applications of enzyme in disease diagnosis, Food industry, Pharmaceutical industry and Paper industry. Enzyme electrodes as biosensors – Calorimetric, Optical and Potentiometric biosensors, Applications of biosensors.

Tutorial: 15 **Total : 60 Hours**

TEXT BOOKS

1. Trevor Palmer, 2001. Enzymes : Biochemistry, biotechnology and clinical chemistry. *East West Press,* Horwood.
2. Zubey, G. Biochemistry
3. Bailey and Ollis, D.F. Biochemical Engineering Fundamentals. *McGraw Hill*. New York.

REFERENCES

1. Butterworth, 1995. Technological Applications of Biocatalysts. *BIOTOL Series.*

   Cornish-Bowden, A., 1996. Analysis of Enzyme Kinetic Data. *Oxford University Press.*

2. Wiseman, A., Blakeborough, N. and Dunnill, P., 1981. Enzymatic and Nonenzymatic catalysis. Vol. 5, *Ellis and Harwood*, UK

3. Wiseman, A. Topics in Enzyme and Fermentation Biotechnology. Vol.5 *Ellis and Harwood*, UK.
4. Kolot, F.B. Immobilized Microbial Systems, Principles, Techniques and Industrial applications. *R.R Krieger Publications*.
5. Rehm, H. and Reed, G. Biotechnology. Vol. I – XII, *Verlag Chemie*.
6. Samuel C. Prescott, Cecil G. Dunn, 2002. Industrial Microbiology. *Agrobios* (India).
7. Tailor, R.F. Protein Immobilisation – Fundamentals and Applications.
8. Gerharts, W. Enzyme Industry – Production and Applications.
9. Klaus Buchholz, 2005. Biocatalyst and Enzyme Technology. *John Wiley and Sons.*
10. Hans Bisswanger, 2004. Practical Enzymology. *John Wiley and Sons*

YEAR	II	PLANT & ANIMAL DISEASES AND THEIR CONTROL	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

The aim is to enhance the knowledge in the field of plant and animal diseases and their control measures.

OBJECTIVES

- To acquire a fundamental knowledge of the life history of natural enemies to Plants and animals and their use in biological control.
- Study the interactions of these biological control agents with their target, host plant, and environment.
- Explore how biological control fits into integrated pest management and sustainable agriculture systems.

OUTCOMES

This course explores the molecular pieces and collective behaviors of pathogen virulence and plant immune systems, similarities between interaction mechanisms in plant and animal pathosystems, and the application of this knowledge to sustainable agriculture.

UNIT-I

CLASSIFICATION OF PESTS AND PESTICIDES 9

Pests – Definition, Morphology and Life cycle, classification of pests – Vertebrate pests, Invertebrate pests and plant pests, Classification of pesticides on chemical nature and according to target species, mode of action.

UNIT -II

AGRICULTURAL PESTS AND THEIR CONTROL 9

Concept of Pest and Types of pests in agricultural products - stored grains- veterinary- forestry and nursery. Major insect pests of agricultural- importance -Marks of identification- life cycle- nature of damage, chestnut blight, potato late blight, downy mildew, Damage economic threshold level and control measures.

UNIT –III

PEST CONTROL PRACTICES 9

Issues, Challenges and Opportunities in the Control of Insects in Vegetable Crops, Control measures- Cultural, Physical, Mechanical, Chemical, Herbal and Biological control. Pheromonal and autocidal control.

UNIT IV **9**

EMERGING CONCEPTS AND PRACTICES IN INTEGRATED CONTROL MEASURES

The integrated control/IPM concept, Damage thresholds, Forecasting, Increasing agro-ecosystem resistance, Pesticide selectivity, Eradication versus control, Pests and humans – direct pests and vectors of plant and animal diseases, potential human practices and the occurrence of pests, Prevention of communicable diseases after the disaster.

UNIT V

SAMPLING AND MONITORING ARTHROPODS **9**

Methods of sampling and monitoring, Components of a sampling plan, Types of sampling plans, Allocation of Sampling units.

Total : 45 Hours

BOOKS

1. Principles and procedures of plant protection, 1993. S.B.Chattopadhyay, Oxford-IBH.
2. Agricultural pests of India and south East Asia - A. S. Atwal, 1986. Kalyani Publishers.

REFERENCES

1. Agricultural insect pests of the crops and their control-D.S.Hill, Cambridge Univ. Press
2. Insect pest of crops - S.Pradhan, National Book trust.
3. Healthy Roses: Environmentally friendly ways to manage pests and disorders in your garden and landscape, 2nd Edition , John Karlik, Mary Louise Flint, and Deborah Golino.

4. Hayes' Handbook of Pesticide Toxicology, Editor-in-Chief: Robert Krieger, University of California, Riverside, U.S.A. Published by January 2010, imprint: Academic Press, ISBN: 978-0-12-374367-1

YEAR	II		L	T	P	C
SEMESTER	**IV**	**PRINCIPLES OF CHEMICAL ENGINEERING**	**3**	**1**	**0**	**4**

AIM

To make the students knowledgeable and help them to understand the principles of stoichiometry in Biochemical processes.

OBJECTIVES

To emphasize the concepts of

- Stoichiometry
- Material balance with and without chemical reaction.
- Principles of Humidity and solubility.
- Principles of Energy balance.
- Principles of Combustion.

OUTCOME

The student will demonstrate ability to

- Use the mole concept and perform calculations involving concentration expressed as mass and molar concentration
- Solve problems related to the quantitative aspects of chemical change; the principles of Stoichiometry
- Apply the gas laws to solve problems related to ideal gases and mixtures
- Perform calculations on vapour gas systems and use humidity charts
- Apply material and energy balances with and without chemical reaction in steady and unsteady state processes.

UNIT I **10**

STOICHIOMETRY

Introduction, Units and dimensions, conversion factors, Stoichiometric principles, Composition relation - Atomic, Molecular, Equivalent weights, Molar concepts - Moles, Mole fraction, Mass fraction, Mixtures and solutions - Molarity, Molality and Normality, Density and specific gravity, Conversion factors, Ideal Gas law, Gaseous mixtures- Dalton's law of additive volumes, Dimensional analysis.

UNIT II **9**

MATERIAL BALANCES

Material balances without chemical reactions - Overall and component balances, Distillation, Evaporation, Drying, Recycling and bypass, Material balance of unsteady state operations. Mate-rial balances with chemical reactions - Limiting reactant, Excess reactant, Recycling and bypass, problems in industrial applications.

UNIT III **9**

VAPOUR PRESSURE, HUMIDITY AND SOLUBILITY

Vapour pressure - Effect of temperature, Humidity and saturation, Vapourization, Condensation, Solubility and crystallization, Dissolution.

UNIT IV **9**

ENERGY BALANCE

Thermochemistry - Calculation of heat of reaction at other temperatures - Hess's law of summation, heat capacity, heat capacities of gases at constant pressure, heat capacities of gas mixture, heat capacities of liquid mixture, Latent heat - Heat of formation, Reaction, Mixing, Theoretical flame temperature.

UNIT V **8**

COMBUSTION

Introduction, Flue gas, Orsat analysis, Theoretical air, Excess air, Determination of products of combustion of solid, liquid and gaseous fuels, Calculation of excess air.

Tutorial: 15 **Total: 60 Hours**

TEXT BOOKS

1. Bhatt and Vora S.M., Stochiometry, 2004, Tata McGraw Hill Publishing Co., 3rd Edition.
2. McCabe, W.L., Smith, J. C. and Harriot, P. “Unit operations in Chemical Engineering”, 2001, McGraw Hill, 7th Edition,
3. Badger W.L. and Banchero J.T., “Introduction to Chemical Engineering”, 1997, 6th Edition, Tata McGraw Hill,.

4. Dryden, C.E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao,M. and M.Sittig, 1993, 2nd Edition, Affiliated East-West press,.
5. Venkataramani V, Anantharaman N, Begum K. M. Meera Sheriffa. Process Calculation. 2011 PHI; 2 edition

REFERENCES

1. David H.Himmelblau, Basic principles and calculations in chemical engineering, 2003, Eastern Economy Edition, 6th Edition.
2. Hougen, O.A. and Watson, K.M.Chemical Process Principles. Vol-I, CBS Publication.
3. Geankoplis, C.J., 2002.Transport Processes and Unit Opera-tions.Prentice Hall India.
4. Pauline M. Doran, 2002. Bioprocess Engineering Principles. Academic Press.
5. George T. Austine, Shreeves chemical process industries, 1984, McGraw Hill Internatinal Edition, 5th Edition.
6. Finlayson, B. A., Introduction to Chemical Engineering Computing, 2006, John Wiley & Sons, New Jersey.

YEAR	II	OCEAN SCIENCE	L	T	P	C
SEMESTER	**IV**		**3**	**0**	**0**	**3**

AIM:

To explore the various aspects of marine environment and to create knowledge in culturing a few marine organisms in the laboratory conditions.

OBJECTIVES

- To know the biology and ecology of marine environment
- To study the diversity of marine micro organisms
- To impart knowledge on the economic values of marine phytoplanktons.

OUTCOMES

Graduates will have a strong fundamental understanding of the physics, biology, chemistry, and geology of the oceans; a rigorous, in-depth knowledge of their specialty; understanding of the principles that guide the design and execution of high-quality research; and experience in the design and execution of original research. Graduates will be able to teach and to communicate scientific issues to the public

UNIT I

INTRODUCTION TO MARINE ENVIRONMENT

Stratification of coastal environment- Bathymetric map, Thermocline, components of marine ecosystem, Biotic and Abiotic and their interrelationships-Role in food chain, food web, Trophic systems. Taxonomy of marine flora and fauna. Physico chemical properties of marine water.

UNIT II

BIODIVERSITY AND BIORESOURCES

Biodiversity of marine ecosystem – Phytoplankton, Algal bloom, Indicator organisms. Bio-geocycles, Bioresources and their economic importance.. Adaptations of flora and fauna in marine & estuarine environment.

UNIT III

CULTURE TECHNIQUES

Culture Techniques of microalgae, seaweeds, tiger shrimp, lobsters. Common marine pathogens and symptoms. Transgenesis and cryopreservation.

UNIT IV

ECONOMIC VALUE

Economic importance of marine products. Economic value- corals, sponges, pearls, oysters, molluscs. Drug development from natural marine derived compounds.

UNIT V

IMPACTS ON MARINE ENVIRONMENT

Human Impact on Marine Environment – Oil spill, Nuclear reactors, Thermal impact, Bio fouling, Heavy metal pollution.

TEXT BOOKS

1. Milton Fingerman and Rachakonda Nagabhushanam, Recent Advances in Marine Biotechnology (Series) Biomaterials and Bioprocessing, Science Publishers 2009.
2. Proksch and Werner E.G.Muller, Frontiers in Marine Biotechnology. Horizon Bioscience, 2006

REFERENCES

1. Le Gal, Y.Ulber, marine Biotechnology 1: Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer – Verlag Berlin Heideberg. Vol. 96,97, 2007
2. Mun and Munn, Marine Microbiology Ecology & Applications. BIOS, Scientific Publisher. 1996

YEAR	II	PRINCIPLES OF BIOINFORMATICS	L	T	P	C
SEMESTER	IV		3	1	0	4

AIM

This course aims to develop the skills of the students in Bioinformatics. This will facilitate the students to undertake projects in the Modern biology.

OBJECTIVES

- Basics of Bioinformatics.
- Sequence Data bases and their uses.
- Introduction to Sequence alignment.
- Evolutionary Tree and Phylogeny.
- Applications of Bioinformatics.

OUTCOMES

A student should be able to apply:

- Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
- Existing software effectively to extract information from large databases and to use this information in computer modeling
- Problem-solving skills, including the ability to develop new algorithms and analysis methods
- An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

UNIT I ***9***

INTRODUCTION TO BIOINFORMATICS

Introduction, Scope of bioinformatics – Introduction to UNIX- Files and processes, Basic UNIX commands for listing files and directories, Making directories, Changing to a different directory, Copying and moving files, Removing files in directories, Clear, CAT and Less commands, Word count, Help, Redirection, Access rights, Running background process and killing processes, ftp, telnet, Internet, http, Search engines.

UNIT II **9**

DATABASES

Introduction to databases – Flat files, Relational databases, Object oriented databases and hypertext databases, Biological databases and their uses, Introduction to EMB net and NCBI, Classification of biological databases; Primary nucleic acid sequence databases – Gen Bank, EMBL, DDBJ; Primary protein sequence databases – PIR, SWISS-PROT; Composite databases – NRDB, OWL, SWISS-PROT+TrEMBL; Secondary databases – PROSITE, PRINTS; Structural databases – PDB, MMDB.

UNIT III **9**

SEQUENCE ALIGNMENT

Introduction to sequence alignment and its significance, Types – Global, Local, Pairwise and Multiple alignment. DOT PLOTS, Scoring matrices – PAM, BLOSSUM. Dynamic programming algorithms, BLAST, FASTA. Multiple sequence alignment by PSI- BLAST.

UNIT IV **9**

PHYLOGENETIC ANALYSIS

Terminology and basics of Phylogenetics – Clades, Taxons, Baranches, Nodes; Orthologs and Paralogs. Steps to construct a Phylogenetic tree – Constructing a Multiple Sequence Alignment, Determining the substitution model, Tree building and tree evaluation.

UNIT V **9**

APPLICATION OF BIOINFORMATICS

Application of bioinformatics in various fields – Medicine, Agriculture and Industries.

Tutorial: 15 **Total : 60 Hours**

TEXT BOOKS

1. Rastogi, S.C., Namita Mendiratta, Parag Rastogi. 2006. Bioinformatics – Concepts, Skills, Application. CBS Publications.
2. Westhead, D.R., Parish, J.H., Twyman, R.M., 2000. Instant Notes in Bioinformatics. *BIOS Scientific Publishers*.
3. Teresa, K., Attwood and David J. Parry-Smith, 2007. Introduction to Bioinformatics. *Pearson Education Ltd*.

REFERENCES

1. Bergeran, B., 2002. Bioinformatics Computing. *PHI*.
2. Richard Durbin, Sean Eddy, Anders Krogh and Graeme Mitchison, 1998. Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids. *Cambridge University Press*.
3. Bishop, M.J., Rawlings, C.J., 1997. DNA and Protein Sequence Analysis. A Practical Approach. *IRL Press*, Oxford.
4. Gibas, C. and Jambeck, P., 1999. Developing Bioinformatics Skills. *O'Reilly*.
5. Dan Gusfield, 1997. Algorithms on Strings Tree and Sequence. *Cambridge University Press*.
6. Baldi, P. and Brunak, S., 1998. Bioinformatics : A Machine Learning Approach. *MIT Press*.

YEAR	II	MOLECULAR BIOLOGY LAB	L	T	P	C
SEMESTER	**IV**		**0**	**0**	**4**	**2**

AIM

The course aim is to offer hands on training in the area of isolation of DNA from various cells. This will serve as a prerequisite for Post graduate and specialized studies and Research.

OBJECTIVES

- The student would have learnt basic techniques used in Molecular biology and its application. This will be strength for student to undertake research projects in the area of Molecular biology.

OUTCOMES

Students should be able to:

- Demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology.
- Demonstrate knowledge and understanding of applications of these techniques.
- Demonstrate the ability to carry out laboratory experiments and interpret the results.

1. Isolation of Bacterial Genomic DNA
2. Isolation of DNA – Isolation of plant Genomic DNA
3. Isolation of Human genomic DNA
4. Isolation of Mitochondrial DNA.
5. Quantification of RNA / DNA.
6. Agarose gel electrophoresis
7. Extraction of DNA from agarose gel.

REFERENCES

1. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning : A Laboratory Manual", Cold spring harbor Laboratory Press, New York, USA.
2. Ausubel, F.M. "Short Protocols in Molecular Biology", 4th Edition, John Wiley, 1999.

YEAR	II	CHEMICAL ENGINEERING LAB	L	T	P	C
SEMESTER	**IV**		**0**	**0**	**4**	**2**

AIM

To develop hands on training in some of the aspects of Chemical engineering.

OBJECTIVES

At the end of this course, the student would have learnt about Filtration, Distillation, Fluidization and Crushing procedures. The knowledge gained can be applied in industries and projects.

OUTCOMES

Students will;

- Plan and conduct lab experiments to solve Chemical Engineering problems.
- Conduct laboratory experiments safely
- Learn how to operate, manipulate, and calibrate engineering machinery and measurement devices
- Collect and analyze experimental data using statistical principles, and compare results to theoretical principles
- Prepare and deliver effective oral presentations that summarize experimental findings and analysis.
- Prepare written lab reports that clearly communicate experimental results, analysis, and relationship to theory.

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Filtration.
3. Heat exchangers.
4. Simple and Steam distillation.
5. Fluidization.
6. Pressure drop in pipes and packed columns.
7. Distillation in packed column.
8. Liquid – liquid equilibria in extraction.
9. Solid liquid extraction
10. Adsorption equilibrium.
11. Jaw crusher.
12. Determination of Screen effectiveness.

13. Sedimentation.
14. Jaw crusher

REFERENCE

1. Laboratory Manual.

YEAR	II	PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT LAB	L	T	P	C
SEMESTER	**IV**		**0**	**0**	**4**	**2**

(Common to All Branches)

AIM: To develop graduates with good Presentation and Writing skills (Professional & Technical)

OBJECTIVES: To improve Aptitude Skills, train to improve self-learning/researching abilities, Presentation Skills & Technical Writing (Reports, Brochures, Manuscripts/Articles)

OUTCOME:

- By teaching this syllabus, our UG Engineering graduates will enable to enhance wide range vocabulary to use at right place in right time.
- Students who undergo this syllabus will fulfill practice in professional writing and comprehension skill and meet the industry requirements.

METHODOLOGY: Modular Evaluation will be done based on Continuous Internal Assessment as Assignments, Short Communications, Proposals, Briefs, Reports, etc. Final Evaluation will be based on a Real-time research article based on current research carried out in the Institution or by any Faculty of the Institution (Good articles can be submitted to Journals co-authored by the Student and Faculty, with affiliation to the Institution)

UNIT I – COMMUNICATION AND SELF DEVELOPMENT: Basic Concepts of Communication; Process of Communication; Types of Formal communication; The Media of Communication; Channels of Communication; Barriers in Communication; How to Overcome Barriers to Communication.

UNIT II - GRAMMAR & SYNTAX: Synonyms; Antonyms; Words used as different parts of speech; Spotting errors; Concord; Principle of proximity between subject and verb. Sentence Structure; Combination and Transformation of sentences; Verb Patterns in English.

UNIT III - READING AND WRITING SKILLS: Purpose and Process of Reading; Reading Tactics; Reading Strategies; Reading Comprehension; Paraphrase; Preparing outlines of paragraph/text. Elements of Effective Writing; Job Application, Bio-data, Personal Resume and Curriculum Vitae; Preparing Agenda and Minutes of a Meeting; Back office job for organizing a conference/seminar; Writing Styles; Scientific and Technical Writing; Summary Writing; Writing paragraphs; Writing Essays.

UNIT IV – LISTENING AND SPEAKING SKILLS: Process of listening; Hard and Soft Skills; Feedback Skills; Essentials of Good Communications; Types of Listening; Barriers to Listening; Note taking and Note making. Skills of Effective Speaking; Component of an Effective Talk; Tone of Voice; Accent, Body Language; Timing and Duration of Speech; Audio-Visual Aids in Speech.

UNIT V – TECHNICAL REPORT, RESEARCH CASE STUDY & REPORTING: Main considerations in writing a good report; Types and Structure of Reports; Collecting Data; Technical Proposals; Visual Aids; General Tips for Writing Reports. Research Case Study and Reporting

Text Book

I The Functional Aspects of Communication Skills, Prajapati Prasad and Rajendra K. Sharma, S. K Kataria & Sons, New Deihl, Rep"nt 2007.

Reference Books

1. Business Communication, Sinha K. K, S. Chand, New Delhi.

2. Business Communication, Asha Kaul, Prentice Hall of India.

3. Business Correspondence and Report Writing' A Practical Approach to Business and

Technical Communication, Sharma, R.C. and Krishna Mohan, Tata McGraw-HilI.

4. A New Approach to English Grammar for High Schools, Madan Sabina, Spectrum Books, New Delhi

SEMESTER V

YEAR	III	IMMUNOLOGY	L	T	P	C
SEMESTER	V		3	0	0	3

AIM

To introduce the science of immunology, to study various types of immune systems, their classification, structure, mechanism of immune activation and to develop the students skills in Immunotechnology.

OBJECTIVES

At the end of the course the students would have learnt about the following

- The immune system, their structure and classification.
- Antibody production and its genetic control.
- Cellular immunology.
- Transplantation and Autoimmunity.
- Techniques in Immunology.

OUTCOMES

- Classify and describe the functions of the major components of the immune system in human body.
- Differentiate the humoral and cell mediated response against infectious antigens.
- Analyze the basis for Immunological disorders and the recent advancement in molecular immunology.
- Identify the appropriate Immunological technique for diagnosis of infectious diseases.
- The students after completing the course would be aware of immune system structure and functions.
- The students would be aware of immunity to various pathogens, how to produce the therapeutic/diagnostic molecules and aware of tumour, allergy and hypersensivity reactions.

UNIT I **9**

INTRODUCTION TO IMMUNE SYSTEM

Phylogeny of immune system, Innate and acquired immunity, Clonal nature of immune response, Organization and structure of lymphoid organs, antigens: chemical and molecular nature, haptens, adjuvants, Cells of immune system – Hematopoiesis and differentiation – B-Lymphocytes, T-Lymphocytes, Macrophages, Dendrite cells, Natural Killer, Lymphocyte activated killer cells,Eosinophils, Neutrophils, Mast cells.

UNIT II **8**

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T cell activation, Estimation of cytokines, Macrophages activation, Macrophage-microbicidal assays, Hypersensitivity.

UNIT III **9**

TRANSPLANTATION AND AUTOIMMUNITY

HLA System, Transplantation – Organ transplantation, Grafting – graft rejection and prevention, Immunosuppression, Immunosuppressive drugs, Autoimmunity – Auto antibodies in human, Pathogenic mechanism, Experimental models of Autoimmune disease, Treatment of Autoimmune disorders.

UNIT IV **9**

MOLECULAR IMMUNOLOGY

Immunity to virus, Bacteria, Parasites, Genetic control of immune response, MHC associated predisposition to disease, Infectious diseases – Malaria, Filariasis, Tuberculosis, Typhoid, Hepatitis, AIDS, Principles and strategy for developing vaccines, Newer methods of vaccine production. Immunodeficiency diseases.

UNIT V **10**

IMMUNOTECHNOLOGY

Antigen-antibody interaction, Agglutination and precipitation, Complement fixation test, Immunodiffusion, Immunoelectrophoresis, Purification and synthesis of antigen, Fluorescence immunoassay – Immuno Fluorescence (IF), SLFIA DELFIA, Fluorescence Activated Cell Sorter, Immunomics.

Total: 45 Hours

TEXT BOOKS

1. Lydyard, P.M., Whelan, A. and Fanger, M.W., 2003. Instant Notes in Immunology. 2nd Edn., *Viva Books Private Limited*.

2. Dulsy Fatima and Arumugam N., 2014. Immunology. *Saras Publications*

REFERENCES

1. Talwar, G.P. and Gupta, S.K., 1992. A Handbook of Practical and Clinical Immunology. Vol. 12., *CBS Publications*.
2. Roitt and Roitt. Immunology.
3. Richard, A., Goldsby, Thomas J. Kindt and Barbara A. Osborne, Kuby. Immunology. IV Edn., *W.H. Freeman and Company*, New York.
4. Goding, J.W., 1983. Monoclonal Antibodies : Principles and Practice. *Academic Press*.
5. Benjamin, E. and Leskowitz, S., 1991. Immunology – A Short Course. *Wiley Liss.*, New York.
6. Kuby J, Immunology, WH Freeman & Co., 7th Edition 2012.

YEAR	III	GENETIC ENGINEERING	L	T	P	C
SEMESTER	**V**		**3**	**1**	**0**	**4**

AIM

To understand the scope of Genetic engineering and its potential impact on virtually all areas of Biology.

OBJECTIVES

To impart advanced technological knowledge through a detailed study on

- The basic concepts and tools of Genetic engineering.
- Cloning vehicles.
- Cloning strategies
- Construction of libraries and gene mapping.
- Gene modifications and applications of recombinant rDNA Technology.

OUTCOMES

- Technical know-how on versatile techniques in genetic engineering.
- An understanding on application of genetic engineering techniques in basic and applied experimental biology.
- Proficiency in designing and conducting experiments involving genetic manipulation.
- The students after completing this course would be aware of how to clone
- Commercially important genes. The students would be aware of how to produce the commercially important recombinant proteins.
- The students would be aware of gene and genome sequencing techniques, microarrays, Analysis of Gene expression and proteomics.

UNIT I **9**

BASIC TOOLS IN GENETIC ENGINEERING

Core techniques in gene manipulations – Cutting and joining of DNA and vectors, DNA labelling Methods, Gene specific and degenerate primer design, DNA amplification using PCR and it's applications, RAPD, RT-PCR, DNA sequencing - Maxam and Gilbert method and Sanger and Coulson enzymatic chain termination method, Nucleic acid hybridization – Southern, Northern and Western.

UNIT II **9**

CLONING AND EXPRESSION VECTORS

Plasmid biology, Plasmids as vectors – pBR 322, Derivatives of pBR 322, pUC vectors, Lambda vectors, *In vitro* packaging, M13 vectors, Cosmids, Phasmids, Retroviral vectors, Baculovirus vectors, Cloning vectors in Gram positive bacteria (p1J101), Cloning vectors in Gram negative bacterium (Col E1, R1, pT181, pSC 101), Expression vectors – Prokaryotic expression vectors *(E. coli, Streptomyces*) and Eukaryotic expression vectors.

UNIT III **9**

CLONING STRATEGIES

Construction of recombinant DNA, Preparation of competent cells, Transformation, Transfection, Selection and screening of recombinants, Cloning in plants, Ti Plasmids of *Agrobacterium*, Structure and function of T-DNA, Gene transfer - Shotgun method, Nuclear injection method.

UNIT IV **9**

GENE LIBRARIES AND GENE MAPPING

Construction and screening of Genomic DNA and cDNA Library, Analysis of gene expression, Chromosome walking, Chromosome jumping, DNA probes, Molecular markers - Variable Nucleotide Tandem Repeats (VNTR's), Short Tandem Repeats (STR), Mini and Microsatellite sequences, Restriction mapping, Transcript mapping, Gene targeting.

UNIT V **9**

GENE MODIFICATIONS AND APPLICATIONS OF RECOMBINANT DNA TECHNOLOGY

Mutagenesis – Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis and their applications, DNA Fingerprinting - RFLP analysis, Applications of recombinant DNA technology for the production of recombinant proteins – Insulin, Interferon and Growth hormones,Safety lines for recombinant DNA techniques and guidelines for the disposal of Bio-waste.

Tutorials: 15 **Total : 60 Hours**

TEXT BOOKS

1. Primrose, S. Twyman, R. "Principles of Gene Manipulation and Genomics" 7th Edition, Blackwell Publishing, 2006

2. Brown, T.A. “Gene Cloning & DNA Analysis: An Introduction”, 5th Edition, Blackwell Publishing, 2006.

REFERENCES

1. Sambrook and Elliot. Molecular Cloning. Vol. III.
2. Winnacker, Ernst – L. “From Genes to Clones : Introduction to Gene Technology”, Panima, 2003.
3. Glover, D. M., 1984. Gene cloning : The mechanism of DNA manipulation. *IRC Press*, Oxford University.
4. Jose Cibelli, Robert P. Lanza, Keith H.S. Campbell, Michael D. West, 2002. Principles of cloning. *Academic Press*.
5. Glick, B.R. and J.J. Pasternak “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, 3rd Edition, ASM, 2003.

YEAR	III	PROTEIN ENGINEERING	L	T	P	C
SEMESTER	**V**		**3**	**0**	**0**	**3**

AIM

This course imparts advance knowledge on Proteins through a detailed study of Protein structure, Characteristic property and Significance in biological systems.

OBJECTIVES

- To gain an understating about molecular interactions in Protein structure
- To focus on the Primary, Secondary, Tertiary and Quaternary structure.
- To gain knowledge about concepts and principles of Protein structure determination.
- To understand the relation between structure and functions of Proteins of particular importance.
- To learn about Protein design principles and Database analysis.

OUTCOMES

On completion of this course student will have improved ability to:

- Analyze the fundamentals characteristics of protein that can be engineered.
- Identify the different approaches to construct and design the proteins.
- Appraise the membrane protein and its receptor properties and function.
- Apply the scope and benefits of protein engineering in drug targeting, therapeutics and in biocatalysts for industry

UNIT I **8**

BONDS AND ENERGIES IN PROTEIN MAKEUP

Covalent and Non-covalent interactions in Protein structure, Translation and Post Translational Modifications

UNIT II **10**

PROTEIN ARCHITECTURE

Primary structure, Secondary structures, Super secondary structures, Topology diagrams, Nucleotide binding folds, Tertiary structures, Modular nature and Formation of complexes in Quaternary structures.

UNIT III **9**

PROTEIN FOLDING AND STRUCTURE DETERMINATION

Protein Denaturation and Renaturation, Protein folding pathways, Stability of folded conformation of proteins, Methods to determine primary, tertiary and quaternary structure - Peptide mapping, Peptide sequencing, Circular Dichroism, Mass spectroscopy and X-ray diffraction.

UNIT IV **10**

PROTEIN STRUCTURE - FUNCTION RELATIONSHIP

Helix-turn-Helix motifs, Cro, Lamda and Trp repressor, Zn fingers, Tata Box binding proteins, Homeodomain, Leucine zippers, Enzyme - Understanding the catalytic design by engineering trypsin, chymotrypsin and elastase.

UNIT V **8**

PROTEIN ENGINEERING AND PROTEIN DESIGN

Site directed mutagenesis, Engineering of T4 Lysozyme and Recombinant Insulin, Protein design - Principles and examples.

Total : 45 Hours

TEXT BOOKS

1. Branden, C. and Tooze,J., 1999.Introduction to Protein structure. 2nd Garland Publishing, NY, USA. Edn.,

2. Thomas E. Creighton, 1993. Proteins. Structure and Molecu-

REFERENCES

1. Moody P.C.E. and Wilkinson A.J., 1990. Protein Engineer-ing. IRL Press,Oxford, UK.

2. Thomas M. Devlin. Text Book of Biochemistry with Clinical Correlations. 4th Edn., John Wiley and Sons, Inc.

3. Doanald Voet and Judith Voet, G., 2001. Biochemistry. 3rd Edn., John Wiley and Sons, 2001.

4. Stefan Lutz and Uwe T. Bornscheuer, 2009. Protein Engineer-ing Handbook. Vol 1 & 2, 1st Edn., Wiley Publishers. 5. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemis-try. 5th Edn., W.H. Freeman and Company.

YEAR	III	DIAGNOSTICS AND THERAPEUTICS	L	T	P	C
SEMESTER	**V**		**3**	**0**	**0**	**3**

AIM

The course offers the fundamental concepts and basic principles of infections, diagnosis and detection of genetic disorders.

OBJECTIVES

Completing the course, the students should be able to

- Explain and interpret the nature of infection.
- Identify the importance of early detection of pathogens.
- Describe the genetic nature of Human diseases.
- Apply his knowledge in current diagnostics of infectious diseases.
- Understand the instrumentation and biosafety aspects involved in molecular diagnosis.

OUTCOMES

Student should be able to diagnose infectious diseases, know their pathogenesis and symptoms to the degree enabling their differential diagnostics, therapy and chemiotheraphy, as well as prophylactic procedure, including after an occupational exposition.

UNIT I **9**

INTRODUCTION

History of infection, Mode of transmissions, Pre-disposing factors of microbial pathogenicity, Normal microbial flora of the human body, Types of infectious diseases, Host - Parasite relationships, Clinical specimens – Collection, Transport and Processing of samples, Interpretation of results.

UNIT II **9**

MICROBIAL, FUNGAL & VIRAL INFECTIONS

Pathogenicity and diagnosis of major bacterial infections : *Streptococcus, Coliforms, Salmonella, Shigella, Vibrio* and *Mycobacterium*, Pathogenicity and diagnosis of major fungal infections : Dermetophytosis, Candidiosis and Aspergillosis, Pathogenicity and diagnosis of major Protozoan infections : Amoebiosis, Malaria, Trypanosomiosis, Leishmaniasis, DNA

and RNA Viruses : Pox viruses, Rhabdo viruses, Hepatitis viruses, Adeno viruses and Retro viruses.

UNIT III **9**

MEDICAL GENETICS

Organization of Human genome,Identifying human disease genes, Genetic disorders, Neonatal and Pre-natal disease diagnostics, Gender identification, Analysis of mitochondrial DNA for maternal inheritance, Gene therapy and other molecular based therapeutic approaches, Genetic counselling.

UNIT IV **9**

METHODS IN MOLECULAR DIAGNOSTICS

Isolation and purification of nucleic acids, Nucleic acid labelling, Hybridization, PCR and types, PCR based molecular typing, Molecular diagnosis of pathogens based on 18S and 16S rRNA sequences, PCR in Forensic science.

UNIT V **9**

INSTRUMENTATION FOR MOLECULAR DIAGNOSTICS

Good Laboratory Practices, Automated DNA sequencing, Microarrays, Different levels of biosafety containments for rDNA experiments, Biosafety aspects of tissue / Cell transplantation.

Total : 45 Hours

TEXT BOOKS

1. Lele Buckingham and Maribeth L. Flaws, 2007. Molecular Diagnostics : Fundamentals, Methods & Clinical Applications.
2. David E. Bruns, Edward R. Ashwood and Carl A. Burtis, 2007. Fundamentals of Molecular Diagnostics.
3. Griffiths, A. J. F., Miller, J. H. and Suzuki, D. T., 2000. An Introduction to Genetic Analysis.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 2002. Biochemistry. *W.H. Freeman and Company*. 5th Edn.

REFERENCES

1. Turner, P. C., McLennan, A. G., Bates, A. D. and White, M. R. H., 2003. Instant Notes in Molecular Biology. *Viva Books Private Limited*.
2. Brown, T. A. Genetics – A Molecular Approach.
3. Lodish, Berk, Zipursky, Matsudaira, Baltimore Darnell, 2000. Molecular Cell Biology. *W.H. Freeman and Company*. 4th Edn.
4. James Watson *et al.,* 1987. Molecular Biology of Gene. *The Benjamin / Cummings Publication Co. Inc.,* California.
5. Benjamin L., 2008. Genes IX. *Jones and Bartlett*.

YEAR	III	**THERMODYNAMICS FOR BIOTECHNOLOGY**	L	T	P	C
SEMESTER	**V**		**3**	**1**	**0**	**4**

AIM

To understand the basic concepts of Thermodynamics, Phase equilibria and Chemical equilibria.

OBJECTIVES

To understand the

- Laws of Thermodynamics and its applications
- Thermodynamic and volumetric properties of pure fluids.
- Properties of Solutions.
- Concepts of Phase equilibrium.
- Principle of Chemical reaction equilibrium.

OUTCOMES:

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

- Explain laws of thermodynamics.
- Apply laws of thermodynamics to biological processes.
- Describe properties of pure fluids and their mixtures.
- Learn and Evaluate thermodynamic laws applied to phase equilibria.
- Apply thermodynamic laws to biological reaction equilibrium.

UNIT I **9**

LAWS OF THERMODYNAMICS AND ITS APPLICATIONS

Introduction - Work, Energy, Heat, Internal energy, Extensive and intensive properties, State and path functions, First law of thermodynamics, Energy balance for closed systems, Equilibrium, The reversible process, Constant - v and Constant - p processes, Enthalpy, Heat capacity, Application of First law to Steady state flow processes, Entropy and Second law of thermodynamics – Limitations of First law, Third law of Thermodynamics.

Heat engines, Thermodynamic temperature scale, Power cycles, Calculation of Ideal work.

UNIT II **9**

VOLUMETRIC AND THERMODYNAMIC PROPERTIES OF FLUIDS

Ideal gas law, Isobaric, Isochoric, Isothermal, Adiabatic and Polytropic process. P-V-T relations of fluid, Equation of state for gases, Compressibility factors, Compressibility charts, The principles of corresponding states, Acentric factor. Thermodynamic properties of fluids – Reference properties, Energy properties, Derived properties, Maxwell's relations. Heat capacity relations, Effect of pressure and volume on heat capacities.

UNIT III **8**

SOLUTION THERMODYNAMICS

Partial molar properties, Concepts of chemical potential and fugacity; Activity and activity co-efficient, Gibbs Duhem equation, Margules activity model**,** Ideal and non-ideal solutions, Excess properties of mixtures, Composition models.

UNIT IV **9**

PHASE EQUILIBRIA

Phase equilibrium – Criteria for phase equlilbria, Phase equilibria in single and multi component systems, Vapour Liquid Equilibria (VLE), Liquid – Liquid Equilibria (LLE), Solid – Liquid Equilibrium.

UNIT V **10**

CHEMICAL REACTION EQUILIBRIA

Equilibrium criteria for homogeneous chemical reactions, Evaluation of equilibrium constant, Effect of temperature and pressure on equilibrium constant, Calculation of equilibrium conversion for single and multiple reactions, Heterogeneous reaction equilibria.

Tutorial : 15

Total : 60 Hours

TEXT BOOKS

1. Narayanan, K.V., 2001. A Text Book of Chemical Engineering Thermodynamics. *Prentice Hall India.*

2. Smith, J.M., Van Ness, H.C. and Abbot, M.M., 2001. Chemical Engineering Thermodynamics. 6th Edn., *McGraw- Hill.*

REFERENCES

1. Rao, Y.V.C. Chemical Engineering Thermodynamics.

2. Sandler, S.I., 1989. Chemical and Engineering Thermodynamics. *John Wiley and Sons.*

3. Roels, J.A., 1983. Kinetics and Energetics in Biotechnology. *Elsevier.*

4. Donald T. Haynie. Biological Thermodynamics. *Cambridge.*

5. Volker Hessel, 2005. Chemical Microprocess Engineering. *John Wiley and Sons.*

6. Irving J. Dunn and Eth Zurich, 2003. Biological Reaction Engineering. *John Wiley*

YEAR	III	IMMUNOLOGY LAB	L	T	P	C
SEMESTER	V		0	0	4	2

AIM

To develop skills of students in Immunology by performing simple experiments in the Laboratory.

OBJECTIVES

At the end of the course the student would have gained knowledge to perform techniques like blood grouping, ELISA and identification of T-cell, Immunofluorescence etc. This will be of help in facilitating the students for project work.

OUTCOME

The students would be aware of immune system cells and tissues.

- The students would have knowledge on immunological /clinical tests.
- The students would be able to isolate lymphocytes and monocytes.
- The students would be able to identify various immune system cells

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood groups.
4. Immunodiffusion
5. Immunoelectrophoresis.
6. Testing for Typhoid antigens by Widal test.

7. Enzyme Linked Immuno Sorbent Assay (ELISA).

8. Isolation of pheripheral blood mononuclear cells.

9. Isolation of monocytes from blood.

10. Immunofluorescence.

REFERENCES

Laboratory Manual.

YEAR	I	GENETIC ENGINEERING LAB	L	T	P	C
SEMESTER	V		0	0	4	2

AIM

To understand and develop the skills involved in rDNA Technology

OBJECTIVES

- To familiarize with core Nucleic acid techniques such as extraction, nucleic acid separations and elution.
- To amplify DNA using Polymerase Chain Reaction.
- To detect and characterize Nucleic acids, through the application of gene probes.
- To acquire skills in Gene cloning and screening of recombinants.
- To analyze proteins through SDS-PAGE.

OUTCOME:

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

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

1. Isolation of Plasmid DNA.
2. Isolation of Bacteriophage Genomic DNA
3. Polymerase Chain Reaction.
4. Electroelution of DNA from Agarose gel.
5. Restriction digestion of λ DNA.
6. Restriction Digestion of Plasmid DNA.
7. Ligation of DNA.
8. Preparation of Competent Cells – Calcium chloride Method.
9. Transformation in *E. coli* by Heat Shock Induction Method.
10. DNA Fingerprinting using Restriction fragment length polymorphism (RFLP)
11. DNA Fingerprinting using Random Amplified Polymorphic DNA(RAPD)
12. Blue White Screening of Recombinants.

13. SDS Poly Acrylamide Gel Electrophoresis.
14. Blotting techniques – Southern, Western

REFERENCES

1. Laboratory Manual.
2. Sambrook, Joseph and David W. Russell "The Condensed Protocols: From Molecular Cloning ; A Laboratory Manual" Cold Spring Harbor Laboratory Press, 2006.

SEMESTER VI

.

YEAR	III	PLANT AND ANIMAL BIOTECHNOLOGY	L	T	P	C
SEMESTER	**VI**		**3**	**0**	**0**	**3**

AIM

To offer a focused study on the important aspects of Biotechnology in plant and animal sciences.

OBJECTIVES

To expose the students to the concepts of

- Media preparation and tissue culture techniques.
- Hybridization and Transformation techniques
- Transgenic plants and Molecular markers
- Transgenic animals and disease diagnosis methods
- Transplantation and patent.

OUTCOMES:

- The course is tailored to provide an understanding of the basic concepts and state of art techniques and methods underlying plant biotechnology research including the genetic basis of several important plant properties and the molecular basis of plant breeding and also provides a basic understanding of animal biotechnology and its applications
- The students will gain an understanding of theoretical principles enabling them to employ the knowledge to solve problems related to plant production and protection through biotechnological approaches, basic pattern of animal breeding and controlling.

UNIT I **10**

BASICS OF TISSUE CULTURE

Tissue culture media – Composition and preparation, aseptic techniques, Tissue culture as a technique to produce novel plants and hybrids, Organogenesis, Somatic embryogenesis, Shoot-tip culture, Embryo culture and embryo rescue, totipotency.

UNIT II **8**

SOMATIC HYBRIDIZATION AND TRANSFORMATION TECHNIQUES

Protoplast isolation, Culture and fusion, Selection of somatic hybrids, Cybrids, Plant vectors, basic features of vectors, Direct gene transfer methods, Agrobacterium mediated gene transfer, applications.

UNIT III **9**

TRANSGENIC PLANTS AND MOLECULAR MARKERS

Herbicide resistance-use of herbicide in modern agriculture, pest resistance-nature, insect resistant crops-Bt approach to insect resistance and food safety. Molecular markers.

UNIT IV **10**

TRANSGENIC ANIMALS AND DISEASE DIAGNOSIS

Basic techniques of animal cell culture and their application, Gene cloning techniques for mammalian cells, Transgenic animals, *In-vitro* fertilization and embryo transfer, Molecular biological technique for rapid diagnosis of genetic disease and gene therapy.

UNIT V **8**

TRANSFECTION METHODS, PATENT AND ETHICAL ISSUES

Gene transfer methods in animals, Xenotransplantation, Manipulation of Growth hormone, thyroid hormone, patenting genetically engineered animals- Ethical issues

Total : 45 Hours

TEXT BOOKS

1. Gupta, P.K., 1996. Elements of Biotechnology. *Rastogi* and Co., Meerut.
2. Ranga, M.M., 2002. Animal Biotechnology. *Agrobios India Limited.*
3. Ignacimuthu, S., 1996. Applied Plant Biotechnology. *Tata McGraw Hill*.
4. Gamburg, O.L. and Philips, G.C., 1995. Plant Tissue and Organ Culture Fundamental Methods. *Narosa Publications.*
5. Singh, B.D., 1998. Text Book of Biotechnology. *Kalyani Publishers.*
6. Ramadas, P. and Meera Rani, S., 1997. Text Book of Animal Biotechnology. *Akshara Printers.*

REFERENCES

1. Hamond, J., McGarvey, P. and Yusibov, V., 2000. Plant Biotechnology. *Springer Verlag.*
2. Mantal, S.H., Mathews, J.A. and Mickee, R.A., 1985. Principles of Plant Biotechnology. An Introduction of Genetic Engineering in Plants. *Blackwell Scientific Publication.*

YEAR	III	GENOMICS AND PROTEOMICS	L	T	P	C
SEMESTER	**VI**		**3**	**0**	**0**	**3**

AIM

To develop advance level skills in the areas of Genomics and Proteomics.

OBJECTIVES

To emphasize the concepts of

- Genome organisation.
- Mapping techniques.
- Micro array techniques.
- 2DE and Mass spectrometry.
- Application of Proteomics.

OUTCOMES:

- Genomics, proteomics and their applications deals with a rapidly evolving scientific area that introduces students into genomes, proteomes and databases that store various data about genes, proteins, genomes and proteomes.
- The main objective is to organize the large amount of information about genomics, proteomics and bioinformatics and offer basic knowledge of genome sequencing, major differences between prokaryotic and eukaryotic genomes, basic proteomics and its applications, basics in bioinformatics, comparative and evolutionary genomics and applications.
- The information obtained during the course should be helpful to those students who want to work in core facilities and commercial biological laboratories as well as in postgraduate studies.

UNIT I **8**

OVERVIEW OF GENOMES OF PROKARYOTES, EUKARYOTES AND HUMAN

Organisation of genes, Coding and non-coding chromosomes and high order structures, Genome relatedness, Introduction of genomics.

UNIT II **9**

MAPPING TECHNIQUES

Mapping strategies, Maps – Physical and Genetic maps, Comparative map, Integrated map, Top down and bottom up approach, linking and jumping of clones, STS maps, Human Genome Project.

UNIT III **9**

FUNCTIONAL GENOMICS

Gene identification and prediction, Annotation, Functional prediction, Gene expression and micro arrays, Substractive DNA library screening, differential display and representational difference analysis, SAGE.

UNIT IV **10**

PROTEOMIC TOOLS

Edman protein microsequencing, Proteome analysis, 2D gel electrophoresis, Metabolic labeling, Detection of protein on SDS gels. Mass spectrometry – MALDI - TOF, Tandem MS - MS, Peptide mass finger printing.

UNIT V **9**

PROTEIN PROFILING AND APPLICATION OF PROTEOMICS

Protein – protein interaction, Post translational modification, Proteomics in drug discovery.

Total : 45 Hours

TEXT BOOKS

1. Rastogi, S.C., Mendiratta, N. and Rastogi, P, 2008. Bioinformatics Methods and Applications. Prentice-Hall of India (Private), Limited.
2. Andreas D. Baxevanis and Francis Oueliette, B.F, 2004. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition. *John Wiley and Sons Inc*.

REFERENCES

1. Liebler, 2002. Introduction to Proteomics. *Humana Prem*.
2. Primrose and Twyman, 2003. Principles of Genome Analysis and Genomics. *Blackwell Publishing Co*.
3. David W. Mount, 2001. Bioinformatics, Sequence and Genome Analysis. *Cold Spring Harbor Laboratory Press*.
4. Pennington and Dunn, 2001. Proteomics. *BIOS Scientific Publishers*.
5. Ignacimuthu, S., 2005. Basic Bioinformatics. *Narosa Publishing House*.
6. Westhead, D.R., Parish, J.H. and Twyman, R.M., 2003. Instant Notes Bioinformatics. 1st Edn., *Viva Books Private Limited*

YEAR	III	GENETICALLY MODIFIED ORGANISMS AND ETHICAL ISSUES	L	T	P	C
SEMESTER	**VI**		**3**	**0**	**0**	**3**

AIM

To understand the concept of GMO's and their ethical issues

OBJECTIVES

After the course the students should be able to :

- Genetically modified organisms was done to describe how genetic modification of microorganisms, animals and plants are carried out
- Understanding the principles of risk-benefit analysis of genetically modified organisms
- To know about the legislation, regulations and ethical values relevant to genetic modification.
-

OUTCOMES

- Knowledge of basic terms of molecular biology and construction of genetically modified organisms
- Knowledge of genetically modified bacteria, fungi, plants and animals in agriculture and food technology at present time

UNIT I **9**

GENETIC MODIFICATION

Generation of Genetic Modification- Genetically Modified Microbes (bacteria and yeast) and Genetically Modified Organism (plants and animals) - Recombinant DNA technology for GMOs with examples of applications in plants - applications of GMM and GMO within basic science- Biological and medical research.

UNIT II **9**

DETECTION AND ANALYSIS OF GMOS AND GMO PRODUCTS

Modified gene copy number determination, detection of chromosomal changes, toxicological studies, residual DNA analysis, product analysis – microbial, biochemical and molecular, toxicological evaluation

UNIT III **9**

BIOCONFINEMEN

Genetically Engineered Organisms –Bioconfinement - Methods of Bioconfinement, International Aspects - History of Confinement - Social Acceptability of Bioconfinement Methods, Risk factors - Effects on Nontarget Species - Delaying the Evolution of Resistance

- Food Safety and Other Issues - Need for Bioconfinement , Execution of Confinement - International Aspects - Bioconfinement - Bioconfinement Research

UNIT-IV **9**

GMO – ETHICS AND ENVIRONMENT

Gene flow and global aspects of genetic modification - ethical, legal, economic and political aspects of genetic modification . Protection of New GMOs; International framework for the protection of IP. IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS, Pollution monitoring: chemical, biological and molecular methods; Environmental impact assessment, Biodiversity and its conservation, GMOs and Biosafety.

UNIT-V **9**

GM FOODS

Hardy variety of rice, Transgenic food crops, Advantages, Adverse effects, Rapeseed (canola oil), HT maize, Bt Brinjal, Field trials and Biosafety. Potential benefits - improved nutritional value - reduced chemical use.

TEXT BOOKS

1. Federov, N. and Brown, N. M. 2004. Mendel in the Kitchen: A scientists view of genetically modified foods. Joseph Henry Press, Washington DC.ISBN 0-309-09738-X.

2. Ruse, M. and Castle, D. 2002. Genetically modified foods: Debating Biotechnology. Prometheus Books, Amherst NY. ISBN 1-57392-996-4.

3. Pringle, P. 2003. Food, Inc.: Mendel to Monsanto-The promises and perils of the biotech harvest. Simon & Schuster Paperbacks, New York NY. ISBN 0-7432-6763-X.

REFERENCES

1. Microbial Metabolism and biotechnology, e-book: Horst Doelle.
2. J. M. Walker and R. Rapley, Molecular Biology and Biotechnology, 4th edition (2002)
3. R. R. Vittal and R. Bhat, Biotechnology, Concepts and Applications (2009)
4. S. C. Rastogi, Biotechnology, Principles and Applications .

YEAR	III	BIOPROCESS ENGINEERING	L	T	P	C
SEMESTER	**VI**		**3**	**1**	**0**	**4**

AIM

This course aim to develop the skills of the students in the area of Bioprocess engineering. This will also help the students to undertake project in Bioprocess technology.

OBJECTIVES

- To study the historical development of Bioprocess technology, Design and construction of Fermenters.
- To study the kinetics of Microbial growth and product formation.
- To strengthen the knowledge on Design and operation of Bioreactors.
- To study the Mass transfer principles in bioreactor and scale-up criterias.
- Methods of Online and Offline monitoring of bioprocess.

OUTCOMES

- Select appropriate bioreactor configurations and operation modes based upon the nature of Bioproducts and cell lines and other process criteria.
- Apply modeling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
- Plan a research career or to work in the biotechnology industry with strong foundation about bioreactor design and scale-up.
- Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.

UNIT I 8

INTRODUCTION TO BIOPROCESS AND FERMENTATION

Historical development of the fermentation industry, General requirements of fermentation process, Basic configuration of fermenter and ancillaries, Main parameters to be monitored and controlled in fermentation processes.

UNIT II **9**

KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Kinetics of Batch, Fed batch and Continuous culture processes, Comparison of batch and continuous culture in industrial process, Introduction to structured and unstructured models – Using unstructured non-segregated models to predict specific growth rate – Substrate limited growth (Monod equation and alternatives to Monod equation), Models with growth inhibitors (Substrate, Product inhibition and Inhibition by toxic compounds).

UNIT III **10**

DESIGN OF BIOREACTORS

Classification of bioreactors – Immobilized enzyme bioreactors, Packed bed bioreactors, Membrane bioreactors, Airlift loop reactor, Fluidized bed and Trickle bed bioreactors, Design

of bioreactors – Aseptic operation and containment, Body construction, Aeration and agitation Types of agitators and spargers, Sterilization of Media, Fermenter, Air supply and Exhaust.

UNIT IV **9**

BIOREACTOR SCALE-UP AND MASS TRANSFER

Scale up of fermentation process – Factors involved in scale-up, Scale-up of aeration / agitation, Oxygen mass transfer in bioreactors, Determination of K_La values – Sulphite oxidation technique, Gassing out technique, Oxygen balance technique, Mass transfer correlations.

UNIT V **9**

MONITORING OF BIOPROCESSES

Methods of measuring process variables – Online and offline analysis for measurement of important biochemical parameters, Biomass estimation, Control systems – Manual and automatic control.

Tutorial : 15

Total : 60 Hours

TEXT BOOKS

1. Shuler and Kargi, 1992. Bioprocess Engineering. *Prentice Hall*.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamental. 2nd Edn. *Mc Graw Hill*.

REFERENCES

1. Trevan, Boffey, Goulding and Stanbury. Biotechnology. *Tata Mc Graw Hill Publishing Co*.
2. Anton Moser. Bioprocess Technology, Kinetics and Reactors. *Springer Verlag*.
3. James M. Lee. Biochemical Engineering. *PHI, USA*.
4. Atkinson. Handbook of Bioreactors.
5. Harvey W. Blanch, Douglas S. Clark. Biochemical Engineering. *Marcel Decker Inc*.
6. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.

YEAR	III	MASS TRANSFER OPERATIONS	L	T	P	C
SEMESTER	**VI**		**3**	**1**	**0**	**4**

AIM

To develop the skills of the students in the area of Mass transfer operations in Biotechnological process.

OBJECTIVES

- To introduce the Mass transfer principles.
- To study in detail about the Principles of absorption.
- To study the Vapour - Liquid Equilibrium.
- To understand the concept of Liquid - Liquid Equilibrium.
- To study the concept of Solid - Fluid operation.

OUTCOMES:

- To build a basic knowledge of mass transfer operations and separation processes carried out in industries.
- To understand the designing of mass transfer equipments used in the chemical industries.
- To utilize the technological methods in problem solving of mass transfer operations in industries.
- To review the practical importance and relevance of mass transfer
- in industries
- To understand the applications of different mass transfer processes.
- To recognize the selection criteria for mass transfer process and equipments required by the industries

UNIT I **8**

DIFFUSION

Molecular diffusion in fluids, Mass transfer coefficients, Diffusion in solids, Inter phase mass transfer, Analogies in Transport Phenomenon

UNIT II **9**

GAS - LIQUID OPERATION

Equipment for gas liquid operation, Principles of gas absorption, Equilibrium solubility of gases in liquid, One component transfer material balance, Counter current multistage operation, Continuous contact equipment, Multi component system, Absorption with chemical reaction.

UNIT III **10**

DISTILLATION

Vapour - Liquid Equilibria, Single stage- Flash vapourization, Differential or simple distillation, Continuous rectification - Binary system, Multistage tray towers - Mc Cabe-Thiele and Ponchon Savarit principles, Continuous contact equipment, Low pressure Distillation

UNIT IV **9**

LIQUID - LIQUID EXTRACTION

Liquid - Liquid Equilibria, Stage wise contact, Stage type ex-tractor, Differential extractor

UNIT V **9**

SOLID - FLUID OPERATION

Adsorption equilibria - Liquids, Single gases and vapours, Adsorption Operations. Drying, Leaching - Unsteady state operation, Steady state continuous operation.

Tutorial : 15

Total : 60 Hours

TEXT BOOKS

1. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., Mc Graw Hill.
2. Geankoplis, C.J., 2002. Transport Processes and Unit Op-erations. 3rd Edn., Prentice Hall of India.
3. Mc Cabe, W.L., Smith, J.C., and Harriott, P., 2005. Unit operations in Chemical Engineering, McGraw Hill, 6th Edition.

REFERENCES

1. Coulson and Richardson's, 1998. Chemical Engineering. Vol. I & II, Asian Books Pvt. Ltd.
2. Badger and Banchero. Introduction to Chemical Engineering. Tata Mc Graw Hill, New Delhi.
3. Pauline M. Doran, 2002. Bioprocess Engineering Principles. Academic Press.
4. Butterworth - Heinemann, 1992. Bioprocess Technology : Modeling and Transport Phenomena.

YEAR	III	**PLANT AND ANIMAL BIOTECHNOLOGY LAB**	L	T	P	C
SEMESTER	**VI**		**0**	**0**	**4**	**2**

AIM

The course aim is to offer hands on training in the area of cell culture and cell identification.

OBJECTIVES:

- To understand the basic techniques in media preparation
- Develop their skills in the animal cell culture techniques.
- To understand the basic techniques in plant tissue culture**.** This will be strength for student to undertake research projects.

OUTCOMES

- To know about the callus formation in plant tissue culture
- To understand the process involved in protoplasmic fusion
- To learn the regeneration of plants in tissue culture
- To learn about how to handle an animal
- Know to handle the animal cell culture techniques

1. Preparation of Tissue Culture Media
2. Callus Induction
3. Shoot tip culture
4. Cell suspension culture
5. Media Preparation for animal tissue culture.
6. MTT Assay
7. Live cell counting
8. Primary cell culture-Chick Embryo Fibroblast
9. Viability checking (Trypan Blue) and cell counting by Hemocytometer
10. Preservation and retrieval of animal cells

YEAR	III	BIOPROCESS ENGINEERING LAB	L	T	P	C
SEMESTER	VI		0	0	4	2

AIM

To provide hands on training by design of simple experiments to learn Bioprocess technology. It also provides an opportunity to experimentally verify the theoretical concepts studied.

OBJECTIVES

- To identify the Growth factors.
- To evaluate Enzyme activity.
- To carry out Enzyme Immobilized Reaction.
- To develop the skills of large scale production of Secondary metabolites.
- To study the Batch and Continuous culture growth.

OUTCOMES

- The student understands about biological and kinetic concepts underlying bioprocesses engineering.
- The student able to learn procedures for the design and control of industrial scale fermentation and biological waste treatment processes.

1. Growth of micro organism – Estimation of Monod parameters.
2. Medium optimization – Plackett Burman design.
3. Enzyme activity – Effect of pH.
4. Enzyme activity – Effect of temperature.
5. Enzyme Immobilization – Gel Entrapment.
6. Enzyme Immobilisation – Cross linking.
7. Production of Wine by Yeast.
8. Production of Amino acid.
9. Production of Yogurt.
10. Study of Rheology of Fermentation broth and Power determination.

REFERENCES

1. Laboratory Manual.

SEMESTER VII

YEAR	IV	FOOD PROCESSING TECHNOLOGY	L	T	P	C
SEMESTER	VII		3	0	0	3

AIM

To impart the knowledge of food processing techniques and make the students learn the nutritional values of various foods including available market food items and fast foods.

OBJECTIVES

- To understand the spoilage and deterioration of common foods
- To explain various food preservation techniques
- To understand healthy food for better life.

OUTCOMES

- Better understanding of significance of food processing and the role of food and beverage industries in the supply of foods.
- Ability to apply knowledge in Identifying and determining the relative amounts of Components in food sample.
- Ability to select the specific preservation technology suitable for a specific food

UNIT –I **9**

FUNDAMENTALS OF FOOD MICROBIOLOGY

Microbiology of different types of foods-Vegetables, fruits, milk and milk products, meat and meat products. Factors affecting the food products. Food borne diseases and causative organisms

UNIT-II **9**

FOOD SPOILAGE AND PRESERVATION

Spoilage of foods and Shelf –life-Milk and milk products, meat and meat products. Factors influening food spoilage. Methods of food preservation-Pickling, salting, drying, freezing, refrigeration, use of food additives and irradiation

UNIT -III **9**

PROCESSING OF FOODS

Heating, boiling, oxidation, toxic inhibition, dehydration, drying-Yeast based products, Milk products, Jams and jellies, Pickles, Meat and meat products. Labelling Instructions.

UNIT- IV **9**

INDUSTRIALIZATION/ MODERN FOOD PRESEVERVATION

Pasteurization, Vaccum packing, food additives, irridation, biopreservation, Modified atmosphere packing, cryopreservation.

UNIT-V PACKAGING AND QUALITY TESTING **9**

Methods of packaging of foods-Solid, liquid, semi solids, Modified atmosphere packing. Factors affecting packaging. Packaging materials.

Total : 45 Hours

TEXT BOOKS

1. Frazier. Food Microbiology. McGraw Hill Publication.4th Edition.2001
2. Sivashankar.B.Food processing Preservation, Prenlice Hall of India.Pvt.Ltd.2002

REFERENCE BOOKS

1. James M Jay, Martin J, Loessner and David A Golden. Food Microbiology, Spinger Publication, 7th Edition. 2005
2. Shetty K, Paliyath, Food Microbiology, 2nd Edition, Taylor and Francis,2006

YEAR	IV	BIOPHARMACEUTICALS	L	T	P	C
SEMESTER	VII		3	0	0	3

AIM

To make the students understand about various concepts involved in the development of drugs and its manufacture as Biopharmaceuticals.

OBJECTIVES

To impart knowledge on

- Drugs and Therapeutic agents.
- Drug action and metabolism.
- Process of manufacturing drugs.
- Preparation, Preservation and Quality testing of drugs.
- Biopharmaceuticals.

OUTCOMES:

- The knowledge gained in this course would be used to understand and evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market.
- This course paves a ways to the students to acquire knowledge on novel biotechnological and pharmaceutical products, current medicines and their applications in therapeutic and diagnostic fields.

UNIT I **9**

INTRODUCTION

Development of Drug and Pharmaceutical industry, Types of therapeutic agents and their uses, Economics and regulatory aspects.

UNIT II **9**

DRUG METABOLISM AND PHARMACOKINETICS

Physico-chemical principles of Drug metabolism, Radioactivity, Pharmacokinetics – different mechanisms of Drug action.

UNIT III **8**

UNIT PROCESSES AND THEIR APPLICATIONS

Bulk drug manufactures, Types of reactions in Bulk drug manufacture and Processes, Special requirements for Bulk Drug Manufacture and its regulatory aspects.

UNIT IV **10**

PRODUCT FORMS AND DEVELOPMENT

Tablets – Compression, Granulation, Presses, Coating, Dosage forms, Topical applications, Preservation of Drugs, Analytical methods and test for various drugs and pharmaceuticals, Packing and Labeling, Quality management, GMP.

UNIT V **9**

BIOPHARMACEUTICALS

Therapeutics – Vitamins, Laxatives, Analgesics, Contraceptives, Antibiotics, Hormones

Total : 45 Hours

TEXT BOOKS

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

REFERENCES

1. Leon Lachman, 1986. Theory and Practice of Industrial Pharmacy. 3rd Edn., *Lea and Febger*.
2. Remington, 1991. Pharmaceutical Science. *Mark Publishing and Co*.
3. Walsh, G., 2003. Biopharmaceuticals : Biochemistry and Biotechnology, 2nd Edn., *John Wiley & Sons Ltd.*
4. Michael E. Aulton, Aulton's Pharmaceutics : The Design and Manufacture of Medicines, 2007, *Elsevier Limited*, Oxford
5. Lieberman, H. A., Lachman, L. and Schwartz, J. B., 1990. Pharmaceutical Dosage Forms : Tablets. Vol. 3, 2nd Edn., *Marcel Dekker Inc*.,

YEAR	IV	DOWNSTREAM PROCESSING IN BIOTECHNOLOGY	L	T	P	C
SEMESTER	VII		3	1	0	4

AIM

To develop the skills of the students in the various aspects of Downstream processing.

OBJECTIVES

To impart knowledge on

- Role of Downstream processing in Biotechnology.
- Physical methods of Separation.
- Isolation of products.
- Product Fractionation and Purification.
- Formulation of the final product and finishing.

OUTCOMES:

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I **10**

DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of Downstream processing in biotechnological processes, Characteristic of Biomolecules and Bioprocesses, Cell disruption for product release - Mechanical, Enzymatic and Chemical methods. Pretreatment and stabilization of bioproducts.

UNIT II

PHYSICAL METHODS OF SEPARATION

Unit operation for solid liquid separation - Removal of Insoluble, Biomass, Flocculation, sedimentation, Centrifugation and Filtration methods.

UNIT III **9**

ISOLATION OF PRODUCTS

Adsorption, Liquid - Liquid extraction, Aqueous two phase extraction, Membrane separation - Ultra filtration and Reverse osmosis, Dialysis, Precipitation of proteins by Various methods –

Salting out, Isoelectric point, Organic solvents, Polyelectrolytes, Polyvalent metallic ions and Non – ionic hydrophilic polymers .

UNIT IV **10**

PRODUCT FRACTIONATION / PURIFICATION

Partition Chromatography – single dimensional and Two dimensional Chromatography –Thin layer chromatography, Gas liquid chromatography, Adsorption Chromatography – Column chromatography and, Ion Exchange Chromatography, High performance liquid Chromatography (HPLC) and Hybrid separation Technology.

UNIT V **8**

PRODUCT FORMULATION AND FINISHING OPERATION

Crystallization - Basic concepts, Crystal size distribution, Batch crystallisation, Continuos crystallization of pharmaceuticals and Solution crystallization , Drying - Drying equipment - Conduction dryers, Adiabatic dryers, Drying rate and Drying time, Zone refining, Lyophilization in final product formulation.

Tutorial : 15

Total : 60 Hours

TEXT BOOKS

1. H. Sivasankaran. Bioseparation
2. Asenjo, J.M., 1993. Separation Processes in Biotechnology. Marcel Dekker Inc.
3. Belter, P.A., Cussler, E.L. and Wei - Houhu, 1988. Bioseparations - Downstream processing for Biotechnology. Wiley Interscience Publications.

REFERENCES

1. Wankat, P.C., 1990. Rate Controlled Separation. Elsevier.
2. Satinder Ahuja., 2000 Volume 2 Handbook of Bioseparations, Academic Press.
3. Janson, J.C. and Ryden, L., 1989. Protein Purification - Principles, High Resolution Methods and Applications. VCH Publication.
4. Scopes, R.K., 1994.Protein Purification - Principles and Practice. Narosa Publication.
5. Jenkins, R.O., 1992. Product Recovery in Bioprocess Technology - Biotechnology by Open Learning Series. Butterworth -Heinemann.

YEAR	IV	NANOBIOTECHNOLOGY	L	T	P	C
SEMESTER	**VII**		**3**	**1**	**0**	**4**

AIM

To introduce the concepts of Nanotechnology and to understand its applications in Biotechnology.

OBJECTIVES

To study about

- The basic concepts of Nanotechnology.
- Fabrication and Characterization of nanomaterials.
- Nanoparticles in biosystems.
- Role of microbes in Nanotechnology.
- Applications of Nanobiotechnology.

OUTCOMES:

- Will familiarize about the science of Nanomaterials
- Will demonstrate the preparation of Nanomaterials
- Will develop knowledge in characteristic Nanomaterial

UNIT I **9**

INTRODUCTION

Introduction to Nanomaterials and their properties, Overview of nanodevices and techniques, Inorganic nanoscale systems for biosystems – Nanostructured materials – Fullerenes: Properties and characterization – Carbon nanotubes : Characterisation and application – Quantum dots and wires – Gold Nanoparticles – Nanopores.

UNIT II **8**

FABRICATION AND CHARACTERISATION

Synthesis – Top-down and Bottom-up Methods, Epitaxial growth, Characterization: X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Scanning Tunneling Microscopy (STM), Atomic Force Microscopy (AFM).

UNIT III **10**

NANOMOLECULES IN BIOSYSTEMS

DNA, RNA, Proteins and Lipids – Nanoscale elements for delivery of materials into cells, Nanotechnology in cell – Cell motility: Nanomotors and cellular navigation – Chemotaxis – Transmembrane signaling and related proteins.

UNIT IV

MICROORGANISMS AND NANOBIOTECHNOLOGY **9**

Nanobiotechnology and microorganisms – Polyhydroxyalkanotes (PHA) Cyanophycin inclusions – Magnetosomes – Alginates s-layer proteins – Bacteriorhodopsin.

UNIT V **9**

APPLICATIONS OF NANOBIOTECHNOLOGY

Nanomedicine, Nanobiosensor – Electrochemical DNA sensors, Nanobiochips, Nanocrystals in Biological Detection, Small scale systems for *in vivo* drug delivery, Nanotechnology for diagnosis and treatment (Cancer and Leprosy), Commercializing Nanobiotechnology. Nanotechnology for disaster relief – Decontamination Emergency equipment, Lab on a chip and sustainability.

Tutorial : 15 **Total : 60 Hours**

TEXT BOOKS

1. Bhushan Bharat (Ed.). Handbook of Nanotechnology. *Springer* 3rd Edition (2010)
2. Ajayan P.A. and Schadler L, Braun P. V., Nanocomposite Science and Technology. *Wiley – VCH* (2003).
3. Nlemeyer, C.M. (Ed.) and Mirkin, C.A. (Ed.) Nanobiotechnology – Concepts, Applications and Perspectives. *Wiley – VCH* (2004)
4. Geoff Ozin and Arsenault, A., Nanochemistry : A Chemical Approach to Nanomaterials. 1st Edn., *Royal Society of Chemistry* (2005)
5. Charles P. Poole and Junior Frank J. Owens, Introduction to Nanotechnology. *John Wiley and Sons* (2003).
6. Jain, K.K., Nanobiotechnology Molecular Diagnostics : Current Techniques and Applications. Horizon Bioscience, *Taylor and Francis*. (2006)

REFERENCES

1. Rosenthal, S.J. and Wright, D.W. Nanobiotechnology Protocols in methods in Molecular Biology Series. *Humana Press* (2005).
2. Michael Crichton. Undestanding Nanotechnology. *Scientific American Publisher* (2002).
3. RalphS. Greco, Fritz B. Prinz and Lane Smithm, R., Nanoscale Technology in Biological systems. *CRC Press* (2005)
4. Nalwa, H.S. Cancer Nanotechnology. *American Scientific Publishers* (2007)
5. Salata, O.V., Applications of Nanoparticles in Biology and Medicine. *J. Nanobiotechnol.*, 2 : 3 (2004).

YEAR	IV	STEM CELL BIOLOGY AND TISSUE ENGINEERING	L	T	P	C
SEMESTER	VII		3	1	0	4

AIM:

To provide a thorough introduction to biological aspects of stem cells and their development.

OBJECTIVES:

- To strengthen the knowledge of students on Stem cell basics and their applications for the benefit of mankind.
- To impart knowledge about stem cell culturing and stem cell signaling.
- To demonstrate current understanding of the concept of scaffold and tissue engineering
- To provide the students with an overview of fundamental concepts in tissue engineering and regenerative medicine

OUTCOMES:

- Ability to understand the components of the tissue architecture
- Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
- Awareness about the properties and broad applications of biomaterials

UNIT: I

INTRODUCTION **8**

Basic biology of stem cells; Types & sources of stem cell with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells, induced pleuripotent stem cells.

UNIT II

STEM CELL CHARACTERIZATIONS **9**

Isolation & characterizations, Human tissue culture media, Culturing of cell lines, Biology and characterization of cultured, Maintenance and management of cell lines, stem cells markers & their identification, growth factor requirements and their maintenance in culture.

UNIT: III

ISOLATION AND CLONING OF STEM CELLS **8**

Protocols for isolation and identification of stem cells, Culturing and subculturing human neurospheres, Differentiation of human neurospheres, mesenchymal cells, Inner cell mass. Immunolabelling procedures, Stem cells and cloning.

UNIT: IV

TISSUE ENGINEERING **11**

Biomaterials in tissue engineering - biodegradable polymers and polymer scaffold processing. Reconstruction of connective tissues, Reconstruction of epithelial or endothelial surfaces – Cells embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Bioreactor design on tissue engineering – Hollow fibre systems, Microcarrier based systems. In vivo cell & tissue engineering case studies: Artificial skin, Artificial blood, Artificial pancreas and Artificial liver.

UNIT: V

APPLICATIONS AND ETHICS

9 Neural stem cells for Brain / Spinal cord repair, Miracle stem cell heart repair, Haematopoietic stem cell therapy for autoimmune disease, Prenatal diagnosis of genetic abnormalities using foetal CD $^{34+}$ stem cells, Embryonic stem cell – A promising tool for cell replacement therapy, Germ-line therapy, Human embryonic stem cell ethics and Public policy.

Tutorial: 15

Total : 60 Hours

TEXT BOOK

Robert Lanza, John Gearhart, Brigid Hogan,Douglas Melton, Roger Pedersen, James ThomsonE and Donnall Thomas.Essentials of Stem cell Biology. Elsevier Academic press.

REFERENCE BOOKS:

1. Stewart Sell. Stem Cell Handbook, 2004. *Humana Press*.
2. Campbell, N.A. and Jane B. Reece, 2002. Biology.6th Edition. *Pearson Education*, Inc. San Francisco, California.
3. Freshney, R. and Ian. Alan, R. Culture of Animal Cells : A Manual of Basic Techniques. Liss Inc.
4. Gamborg, O. L. and Phillips, G.C., 1995. Plant Cell, Tissue, and Organ Culture: Fundamental Methods. *Springer-Verlag,* Berlin Heidelberg.
5. Modlinske, J.A., Reed, M.,A., Wagner, T.E. and Karasiewicz, J., 1996. EmbryonicStem Cells: Developmental Capabilities and their Possible Use in Mammalian Embryo Cloning. *Animal Reproduction Science* 42 : 437 – 446.

YEAR	IV	WASTE MANAGEMENT	L	T	P	C
SEMESTER	VII		3	0	0	3

AIM

To explore the various aspects of waste generation and characteristics and to create knowledge in waste minimization and management

OBJECTIVES

- To study the characteristics of different types of wastes
- To impart knowledge on waste handling and management techniques

OUTCOME:

- Explain municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies
- Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste
- Select the appropriate method for solid waste collection, transportation, redistribution and disposal**.**
- Describe methods of disposal of hazardous solid waste.

UNIT I **9**

GENERATION AND CHARACTERISTICS OF WASTE

Types and characteristics of wastes- Domestic, Industry, Commercial, Agriculture, Health care centre and e-waste.

UNIT II **9**

PRINCIPLES OF WASTE MANAGEMENT

Waste hierarchy, Life cycle of Products, Resource efficiency, Polluter Pays principles, Waste to energy, Benefits of waste management.

UNIT III **9**

WASTE MINIMIZATION AND MONITORING

Waste minimization techniques in the developed and developing countries. Waste minimization techniques adopted in few industries-Sugar, Paper, Textile, Leather, Breweries and Pharmaceuticals.

UNIT IV **9**

WASTE HANDLING AND TRANSPORT

Methods of waste handling, transport and disposal in various sectors of waste generation-Sugar, Paper, Textile, Leather, Breweries, health care centre and Pharmaceuticals.

UNIT V **9**

RESOURCE RECOVERY

Methods of resource3 recovery-3Rs, Landfills, Biological reprocessing, Energy recovery. Modern techniques of disposal-Incineration, Pyrolysis.

TEXT BOOKS

1. Jacqueline Vaughn, Waste Management: A reference Handbook, Science, 2009.

REFERENCE BOOKS

1. Nicky Scott, Reduce, Reuse, Recycle, McGraw-Hill, 2007.

2. George Techobanoglous, Handbook of solid waste management, McGraw-Hill, 2002.

YEAR	IV	FOOD PROCESSING TECHNOLOGY LAB	L	T	P	C
SEMESTER	VII		0	0	4	2

AIM

The Course aims to promote the chances of entrepreneurial success and to create Trained and skilled human resources well versed in engineering aspects of food processing to cater the needs of the rapidly growing food processing sector.

OBJECTIVES

- Students can gain the basic knowledge about the preparation of instant and Convenience food.
- Students can know about the techniques to improve the nutritive value and Minimize loss of essential nutrients during processing and preservation.
- Identification of appropriate processing, preservation, and packaging method.
- To impart knowledge of different methods of fruits and vegetable processing.
- Observe and understand the principals involved in preparation of different Food stuffs

OUTCOME

- Ability to select the specific preservation technology suitable for a specific food
- Ability to Process the different categories of food

1. Preparation of orange squash.
2. Preparation of mango jam and guava jelly.
3. Preparation of tomato ketchup
4. Preparation of canned peas/ pine apple.
5. Preparation of mango pickle /garlic pickle
6. Experiment on preparation of fruit bar.
7. Preparation of frozen prawn.
8. Experiment on preparation of sauce
9. Preparation of bread
10. Identification of Adulterants

1. Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press, 2006

YEAR	IV	DOWNSTREAM PROCESSING ENGINEERING LAB	L	T	P	C
SEMESTER	VII		0	0	4	2

AIM

To develop hands on training in the various techniques used in Downstream Processing.

OBJECTIVES

- At the end of this course, the student would have learnt about techniques like Solid-liquid separation, Cell disruption, High resolution purification, Product polishing. These experiments will enable the students to have a deeper understanding about the techniques.

OUTCOMES:
Upon success completion of this course, the students would have

- Acquired knowledge for the separation of whole cells and other insoluble ingradients from the culture broth.
- Learned cell disruption techniques to release intracellular products
- Learned various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
- Learned the basic principles and techniques of chromatography to purify the
- Biological products and formulate the products for different end uses.

1. Solid-Liquid Separation – Centrifugation, Micro filtration.
2. Mechanical cell disruption – homogeneizer
3. Cell Disruption Techniques – Ultra sonication.
4. Separation of Pigments by Thin Layer Chromatography.
5. Precipitation – Ammonium Sulphite Precipitation.
6. Ultra Filtration Separation.
7. Aqueous Two Phase Extraction of Biologicals.
8. Flocculation

REFERENCES

1. Laboratory Manual.

SEMESTER VIII

YEAR	IV	ELECTIVE III	L	T	P	C
SEMESTER	VIII		3	0	0	3

YEAR	IV	ELECTIVE IV	L	T	P	C
SEMESTER	VIII		3	0	0	3

YEAR	IV	ELECTIVE V	L	T	P	C
SEMESTER	VIII		3	0	0	3

YEAR	IV	PROJECT VIVA VOCE	L	T	P	C
SEMESTER	VIII		0	0	12	6

ELECTIVE		CANCER BIOLOGY	L	T	P	C
			3	0	0	3

AIM

To impart a detailed knowledge in the area of Cancer biology.

OBJECTIVES

To expose and make the students understand the concepts of

- Basics in cancer biology.
- Mechanism of carcinogenesis.
- Oncogenes.
- Pathogenesis of cancer.
- Therapeutics of cancer.

OUTCOMES:

The course would facilitate the students

- To appreciate the role of immune system in cancer
- To describe self – tolerance machinery and immune surveillance
- To understand the cancer microenvironment and its influence on immune cells
- To have awareness on medical applications of cytokines and immune cells against Cancer

UNIT I **9**

FUNDAMENTALS OF CANCER BIOLOGY

Cell cycle and check points, Cancer mechanism, Receptors, Signal molecules, Signal transduction – Modulation study, Tumour suppressor gene, Different forms of cancers, Diet and cancer. Detection using biochemical assays, Tumor markers, Molecular tools for early diagnosis of cancer.

UNIT II **9**

PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, Metabolism of carcinogenesis, Principles of physical carcinogenesis – X - ray radiation, Mechanism of radiation carcinogenesis.

UNIT III **9**

PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

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 **9**

PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, Heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion, Angiogenesis.

UNIT V **9**

NEW MOLECULES FOR CANCER THERAPY

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 : 45 Hours

TEXT BOOKS

1. Maly, B.W.J., 1987. Virology A Practical Approach. IRLI Press, Oxford.
2. Dunmock, N.J. and Primrose, S.B., 1988. Introduction to Modern Virology. Blackwell Scientific Publications, Oxford.

REFERENCES

1. An Introduction Top Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.

2. Primrose, S.B. and Twyman, R.M., 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing.3. Lewis J. Klein Smith, 2005. Principles of Cancer Biology. Benjamin Cummings.

4. Momna Hejmadi, 2000. Introduction to Cancer Biology. Asian Publishing Exchange Pvt. Ltd. 5. Leonard Maurice Franks L., Natalie N., 2007. Cellular and Molecular Biology of Cancer. Oxford University Press.

ELECTIVE		BIOINDUSTRIES AND ENTREPRENUERSHIP	L	T	P	C
			3	**0**	**0**	**3**

AIM

To understand the basics of entrepreneurship and concepts involved in Bio entrepreneurship.

OBJECTIVES

To discuss in detail about the Entrepreneurship in biotechnology oUnderstanding biotech invention and the FDA approval process oBiotech demand and investment oRisk management considerations for Biotech investors oR & D for entrepreneurship

OUTCOMES:

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

- Determine relevant licensing and regulatory issues for a specific small business plan.
- Develop the marketing plan component for a specific bio – industry and the operation plan component for a bio-industry.
- Develop the customer service plan component and to present and defend business reports in a professional manner.
- Develop strategies for ongoing personal and professional development and advancement

UNIT I **9**
ENTREPRENEURSHIP IN BIOTECHNOLOGY

Concepts of Entrepreneurship – Intellectual capital and profiling, Bioentrepreneurship – Pharma, Food and cosmetics, Beneficiary aspects to the society.

UNIT II **9**
UNDERSTANDING BIOTECH INVENTION AND THE FDA APPROVAL PROCESS

Biotechnology inventions and Patents, FDA Approval Process for drugs, Stages of FDA Approval process.

UNIT III
9 BIOTECH DEMAND AND INVESTMENT

Introduction to Biotech investing: Value investing, Growth in-vesting, The industry life cycle, Biotechnology investment trading rules, Bioindustry - Global and Indian Scenario, Policy Enviroment of Biotech Industries in India. Government funding for Bio-technology, Venture capital financing of Biotechnology, Percep-tional analysis of biotech companies (A case study).

UNIT IV

9 RISK MANAGEMENT CONSIDERATIONS FOR BIOTECH INVESTORS

Retention of position and Associated Risk, Liquidation of posi-tion and reinvestment of Net proceeds, Hedging, Monetizing and Diversification Strategies.

UNIT V

9 R & D FOR ENTREPRENEURSHIP

Knowledge centres like universities and research institutions; Role of technology and upgradation; Assessment of scale of devel-opment of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies. Global demand for Biomass and biofuels: Technologies, Markets and Policies

Total : 45 Hours

TEXT BOOKS

1. Mark Tang C., 2007. The Essential Biotech Investment Guide, World Scientific

2. Damina H. and John K., 2006. Innovations and Entrepreneur-ship in Biotechnology. Edward Elgar Publications.

REFERENCES

1.Holger Patzelt, Thomas Brenner, 2007. Hand Book of Bio entrepreneurship. Springer.

2. Satyanarayana Chary and Mishra, R.K. Venture Capital Fi-nancing for Biotechnology. Concept Publishing Company.

3. Alain Vert's, Nasib Qureshi, Hideaki Yukawa and Hans Blascheck, 2007. Biomass to Biofuels : Strategies for Global Indus tries. Wiley & Sons. 4. Bioentrepreneurship : Building a Biotechnology Company from the Ground Up.1998. Nature Biotechnology, Volume 16. 5. Joseph Alper, 1999. Bioentrepreneurship: Maintaining Fi-nancial Stability, Nature Biotechnology.

ELECTIVE		DRUG TESTING & CLINICAL TRIALS	L	T	P	C
			3	**0**	**0**	**3**

AIM

To understand the basics of drug testing & clinical trials.

OBJECTIVE

This subject covers an in-depth concepts and basic analytic methods pertaining to the design, analysis, and interpretation of clinical research studies.

OUTCOME

- The course will give the participants knowledge of guidelines and other relevant documents associated with execution of clinical trials.
- The students will know the different trial phases, research methology, ethical considerations, quality assurance, evaluation of results and statistical methods used in clinical trials.

UNIT I

REGULATION FOR LABORATORY ANIMAL CARE AND ETHICAL REQUIREMENTS

Introduction to commonly used experimental animals and their limitations in biological screening.Guidelines for care and handling of laboratory animals CPCSEA (including IAEC), OECD, ICH, GLP and ICMR Guidelines. Proforma (s) for performing experiments on animals as per various guidelines. Maintenance and Breeding techniques for laboratory animals. Organization of screening: Pharmacological activity of new substances and safety assessment tests. Toxicity studies: acute, subacute (Repeated dose), subchronic and chronic toxicity.

UNIT II

PRINCIPLES OF BIOLOGICAL STANDARDIZATION

Methods of biological assay, principles of biological assays, official bioassays of some important

drugs (Digitalis, insulin, nor adrenaline and histamine).Modern Techniques and New Approaches in drug evaluations: Animal cell lines and their uses, Radioligand binding assay.

UNIT – III

INTRODUCTION TO CLINICAL TRIALS

Glossary of terms in clinical trials, history, requirements, new drug development process, need for new drug, selection of a chemical compound as a potential drug, screening of chemical compounds, translation medicine, assessment of preclinical data, Goals of clinical trials- Target population and patient selection.

UNIT- IV

PHASES OF CLINICAL TRIALS AND LEGAL ISSUES IN CLINICAL TRIALS

Phase 1, Phase 2, Phase 3 studies, Phase 4, Drug regulations- National- good clinical practice and schedule Y, Critical evaluation of literature- Systematic review and meta analysis, evidence based medicine

UNIT – V

PROCESS OF CONDUCTING A CLINICAL TRIAL

Drug development ,The process of ethical approval ,pre-study organization, protocol design, case Report Form (CRF) design ,Informed consent ,ethics approval, monitoring & Source Data Verification (SDV) ,safety Assessment - Good Clinical Practice Guidelines (GCP) & adverse events ,essential documentation, audit & inspections.

TEXTBOOK

Friedman LM, Furberg CD, DeMets DL**.** *Fundamentals of Clinical Trials*. 4th ed. New York, NY: Springer; 2010.Additional Reading Parmigiani, G. (2002). Modeling in Medical Decision Making: A Bayesian Approach, John Wiley and Sons.

REFERENCES

1. Shein-Chung Chow, Jen-Pei Liu, Design and Analysis of Clinical Trials: Concepts and Methodologies.

2. Eleanor McFadden (2007), Management of Data in Clinical Trials, Frontier Science , Ltd.

3. Susanne Prokscha (2011) Practical Guide to Clinical Data Management.

4. Richard K.Bondel, Sheila A.Varley, Colin F.Webb,(2000),Clinical Data Management, Second Edition, Wiley Publications.

6. John I. Gallin, Frederick P. Ognibene (2012), Principles and Practice of Clinical Research, Elsevier Publications.

ELECTIVE	PLANT METABOLITES AND METABOLOMICS	L	T	P	C
		3	**0**	**0**	**3**

AIM

To impart the knowledge of the plant metabolites and their economic and therapeutic values.

OBJECTIVES

- -To understand the significance of the plant metabolites and their production
- -To impart knowledge on therapeutic values of the secondary metabolites

OUTCOMES

- Ability to evaluate the influence selected secondary metabolites on plants
- Ability to evaluate the influence selected secondary metabolites on animals and human
- Knowledge biochemical pathway of secondary metabolism in plants
- Knowledge secondary metabolites in plants

UNIT I

PLANT METABOLISM AND METABOLOMICS

Plant and microbial metabolism-Significance and types-primary and secondary. Metabolism of primary and secondary metabolites. Metablomics- Analytical techniques.

UNIT II

CLASSIFICATION OF SECONDARY METABOLITES

Basic classification of secondary metabolites and their importance-Alkoloids, Terpenoids, Essential oils, Phenols, Flavonoids, Tanins, Glycosides,Saponins.

UNIT III

MEDICINAL VALUES OF SECONDARY METABOLITES

Secondary metabolites – As growth promoters, plant defense, medicine, flavoring agents, cosmetics, anti inflammatory and anti cancer agents.

UNIT IV

PRODUCTION OF SECONDARY METABOLITES

Plant cell and tissue culture- organ culture, precursor addition for improvement, Elicitation, Production of Taxol, L-DOPA, Morphine and codeine.

UNIT V

APPLICATIONS OF SECONDARY METABOLITES

Applications of secondary metabolites in industries- Pharmaceutical, cosmetics, food, medicines, agriculture.

TEXT BOOK

1. Hiroshi Ashihara, Alan Crozier, Atsushi Komamine, Plant Metabolism and Biotechnology, Wiley, 2007.

REFERENCE BOOKS

1. Makkur, Harinder PS, Sidhuraju P, Becker, Klaus, Plant secondary metabolites, Springer, 2007.
2. Alan Crozier, Micheal N, Clifford Hiroshi Ashihara, Plant secondary metabolites, Wiley,2007.

		L	T	P	C
ELECTIVE	**BIOPROCESS ECONOMICS AND REACTOR DESIGN**	**3**	**0**	**0**	**3**

AIM

To enhance the skills of the students in the area of Bioprocess Economics and Plant Design.

OBJECTIVES

To learn about

- Business Organizations.
- Project Design and Development.
- Cost Estimation and Profitability.
- Economics and Plant Design.
- Quality control requirements.

OUTCOME

On completion of this course students will have improved ability to:

- Analyze the design concepts.
- Design the pressure vessel and its auxiliary units as per standard.
- Apply the Computed aided plant design.

UNIT I **9**

PROCESS ECONOMICS AND BUSINESS ORGANIZATION

Definition of Bioprocess, Bioprocess economics, Globalization concept – Competition by dumping – Its effect on plant size – Status of India with adjoining ASEAN countries (Singapore, Malaysia, Indonesia, etc.,) – Project profile concept – Detail; Structure and types of organizations; Simple management principles.

UNIT II **9**

PROJECT DESIGN AND DEVELOPMENT

Choosing a project, Market survey, Importance of Techno – Economic – Viability, studies, Sourcing of processes, Fixing most economic processes, Technology scanning, Plant location principles, Plant lay out, Process flow sheets, Preparation of budgetary investment and production costs.

UNIT III **9**

COST ESTIMATION, PROFITABILITY AND ACCOUNTING

Capital investment, Concept of time-value of money, Source sink concept of profitability, Capital costs, Depreciation, Estimation of capital costs, Manufacturing costs, Working

capital, Profitability standards, Project profitability evaluation, Alternative investments and replacements, Annual reports, Balance sheets, Performance analysis.

UNIT IV **9**

PROCESS OPTIMIZATION TECHNIQUES

Optimum design – Design strategy, Determination of optimum conditions, Optimum production rates, Optimum conditions for cyclic and semi – cyclic operation, Linearization.

UNIT V **9**

QUALITY CONTROL

Current good manufacturing practices. Concepts of quality control in 20^{th} century; Elements of quality control envisaged by ISI since 1947; Emergence of statistical process control(SPC), Simple SPC concept details, Fundamental concepts of ISO 9000 quality system and the various requirements for ISO certification.

Total : 45 Hours

TEXT BOOKS

1. Senapathy, R., 2001. Text Book of Principles of Management and Industrial Psychology. *Lakshmi Publications.*
2. Bhaskar, S., 2003. Engineering Economics and Financial Accounting. *Anuradha Agencies.*

REFERENCES

1. Rudd and Watson, 1987. Strategy for Process Engineering, *Wiley Publications*.
2. Gupta, C. B., 2006. Management – Theory and Practice. 9^{th} Edn., *Sultan Chand & Sons*.
3. Peters, M. S. and Klaus, D., 1991. Plant Design and Economics for Chemical Engineers, Chemical Engineering Series. *Mc Graw Hill International Edition*.
4. Roger G. Harrison, 2003. Bioseparations Science and Engineering. *Oxford University Press*.
5. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamentals. 2^{nd} Edn., *Mc Graw Hill*.

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

AIM

To introduce the concepts of Quality, TQM, Statistical process control and management.

OBJECTIVES ***(Common to all branches)***

- To understand the Total Quality Management concept and principles
- The various tools available to achieve Total Quality Management.
- To understand the statistical approach for quality control.
- To create an awareness about the ISO and QS certification process and its need for the industries.
- To understand the statistical approach of quality systems involved

UNIT I **9**

INTRODUCTION

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II **9**

TQM PRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III **9**

STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV **9**

TQM TOOLS

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V **9**

QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits.

Total: 45 Hours

TEXT BOOKS

1. Dale H. Besterfiled, *et al*., 1999. Total Quality Management. *Pearson Education Asia*.
2. Feigenbaum, A.V., 1991. Total Quality Management. *McGraw - Hill*.

REFERENCES

1. James R. Evans and William M. Lidsay, 2002. The Management and Control of Quality. 5th Edn., *South-Western (Thomas Learning).*
2. Oakland, J.S., 1989. Total Quality Management. *Butterworth – Hcinemann Ltd*., Oxford.
3. Narayana V. and Sreenivasan- N.S, 1996. Quality Management – Concepts and Tasks. *New Age International*.
4. Suganthi, L. and Anand Samuel, 2006. Total Quality Management. *Prentice Hall (India) Pvt. Ltd.*
5. Janakiraman, B. and Gopal, R. K, 2006. Total Quality Management – Text and Cases. *Prentice Hall (India) Pvt. Ltd*.

ELECTIVE	CRYOPRESERVATION THEORY AND APPLICATIONS	L	T	P	C
		3	**0**	**0**	**3**

AIM

To impart knowledge on the fundamentals, basic concepts and principles involved in Cryopreservation.

OBJECTIVES

To study in detail about the

- Principles of cryopreservation.
- Cryogenics and *ex situ* conservation.
- Cellular cryobiology and anhydrobiology.
- Embryo cryofreezing and cryopreservation.
- Cryopreservation in therapeutics and aquaculture.

OUTCOMES

- It provides detailed theoretical and practical knowledge of Cryopreservation of sperms and embryos.
- The course deals exhaustively familiar with freezing techniques, instruments and protocols related to sperm, oocytes, embryos and blastocysts.

UNIT I **9**

INTRODUCTION

Cryopreservation – History and Definition, temperature factor – normal biochemical reaction leading to death, Damages caused by general freezing of cell and tissues, Natural cryopreservation, Gaia theory (James Love Lock), freezing and refrigeration.

UNIT II **9**

VARIATION IN CRYOPRESERVATION

Cryobiology, Cryogenics, Frozen zoo, *ex situ* conservation, Long time preservation.

UNIT III **9**

TECHNOLOGY OF CRYOPRESERVATION

General Biotechnology in cryopreservation, Cellular cryobiology and anhydrobiology, Deep freezing damages, *in vitro* storage and cryopreservation.

UNIT IV **9**

CRYOPRESERVATION AND FERTILITY

Fertility failures, Embryo cryofreezing, techniques in embryo freezing, Storage thawing, retrieval, Cryoprotectant solution.

UNIT V **9**

CRYOPRESERVATION MAN'S HOPE

Cryopreservation of egg, Sperm of *Homosapiens*, Techniques employed in aquaculture (Fish Plankton), Cawthron collection, Design and use of thermal transport containers for cryopreservation, Role of cryopreservation in therapeutics.

Total : 45 Hours

TEXT BOOKS

1. Annamaria Pardo, John M. Baust and Todd Upton, 2005. Improving Quality in Cryopreserved Cells.
2. Gardner, Weissman, Howles and Shoham, 2009. Textbook of Assisted Reproductive Technology. *Informa Health Care*. 3rd Edn.

REFERENCES

1. Walvekar, V. R., Jassawalla, M. J., Anjaria, P. H. And Wani, R. J., 2001. Reproductive Endocrinology. Federation of OGS of India. *Jaypee Publications*. 2nd Edn.
2. Benson, E., Paul T. Lynch and Glyn N. Stacey, 1998. Advance in Plant Cryopreservation Technology Current Application. *Erica*.
3. Peter R. Brinsden, 2005. Textbook of in vitro Fertilization and Assisted Reproduction – Guide to Clinical Lab Practice. *Taylor & Francis*. 3rd Edn.
4. Steven R. Bayer, Michael M. Alperand Alan S. Perzias, 2007. Handbook of Infertility. *Informa Health Care*. 2nd Edn.
5. Igor I. Katkov, 2012. Current Frontiers in Cryopreservation. *Intech Publisher*.

ELECTIVE	IMMUNOTECHNOLOGY	L	T	P	C
		3	**0**	**0**	**3**

AIM

To provide an in-depth understanding of the techniques and the concepts in immunotechnology.

OBJECTIVES

To emphasize the concepts of

- Antigens, Antibodies and Immunodiagnosis.
- Assessment of Cell Mediated Immunity.
- Immunopathology.
- Molecular Immunology.
- Recent Trends in Immunology.

OUTCOMES

- Basic Understanding of Immunotechnology
- Basic Understanding of various immunological techniques
- Application of immunological techniques for human health

UNIT I **10**

ANTIGENS, ANTIBODIES AND IMMUNODIAGNOSIS

Types of antigens, Structure, Preparation of antigens for raising antibodies, Handling of animals, Adjuvants and their mode of action. Monoclonal and polyclonal antibodies – Their production and characterization, Western blot analysis, Immuno electrophoresis, SDS-PAGE, Purification and synthesis of antigens, ELISA – Principle and applications, Radio Immuno Assay (RIA) – Principles and applications, Non isotopic methods of detection of antigens – Enhanced chemiluminescence assay.

UNIT II **9**

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T cell activation parameters, Estimation of cytokines, Macrophage activation, Macrophage microbicidal assays, I*n vitro* experimentation – Application of the above technology to understand the pathogenesis of infectious diseases.

UNIT III **9**

IMMUNOPATHOLOGY

Preparation of storage of tissue, Identification of various cell types and antigens in tissues, Isolation and characterization of cell types from inflammatory sites and infected tissues, Functional studies on isolated cells, Immuno cytochemistry – Immuno fluorescence, Immuno enzymatic and immuno ferritin techniques, Immuno electron microscopy.

UNIT IV **9**

MOLECULAR IMMUNOLOGY

Preparation of vaccines, Application of recombinant DNA technology for the study of the immune system, Production of antidiotypic antibodies, Catalytic antibodies, Application of PCR technology to produce antibodies and other immunological reagents, Immunotherapy with genetically engineered antibodies.

UNIT V **8**

CURRENT TOPICS IN IMMUNOLOGY

Trends in immunology of infectious diseases and tumors, Topics as identified from time to time.

Total : 45 Hours

TEXT BOOKS

1. Talwar, G.P., and Gupta, S.K., 1992. A Handbook of Practical and Clinical Immunology. Vol. I & II. *CBS Publications*.
2. Weir, D.M., 1990. Practical Immunology. *Blackwell Scientific Publications, Oxford.*

REFERENCES

1. Austin, J.M. and Wood, K.J., 1993. Principle of Cellular and Molecular Immunology. *Oxford University Press*, Oxford.
2. Ivan Roitt, 2002. Essential Immunology. 10th Edn., *Blackwell Scientific Publication*.
3. Kuby, J., 2002. Immunology. *W.H. Freeman and Company*, New York.
4. Parham and Peter, 2005. The Immune System. 2nd Edn., *Garland Science*.
5. Ivan Roitt, Jonathan Brostoff and David Male, 2002. Immunolgy, 5th Edn., *Mosby Publication*.

ELECTIVE	WOMEN AND ENVIRONMENT	L	T	P	C
		3	**0**	**0**	**3**

AIM

To emphasis the pattern of Socialism related to gender and to develop and appropriate action towards sustainable development.

OBJECTIVES

- To understand the basis discrepancies and contributions of women to the environment.
- To impart awareness about ecofeminism

OUTCOMES

Upon graduation, our majors are expected to be able to:

- Describe how the effects of gender, sexuality, race, class and nation intersect in the construction of identity and institutional formations.
- Understand and evaluate major theories and texts central to Women's, Gender, and Sexuality Studies.
- Conduct research using feminist methodologies.
- Use feminist frameworks to analyze the structure of gendered representations in media, language, and texts.
- Demonstrate critical and analytic thinking skills.
- Apply acquired knowledge toward academic, professional, and personal development.

UNIT I

WOMEN AND SOCIETY

Distinct role of Women in Society, Economic development, Visions to family and community development, Source of Knowledge and expertise environment management an integral approach - Women in sustainable development

UNIT II
WOMEN AND ENVIRONMENT

Women's attitude on Environment- Environmental Pollution, Global trends – direct effect on women – over population and its results, Perception of environment with reference to global changes, Women in water and waste management.

UNIT III
WOMEN AND EQUALITY

Gender related aspects of environment - inequality, Home loans for women, Job regulations and guidance, International affirmations of women's right in environment and development.

UNIT IV
ENVIRONMENT MOVEMENTS

Environment Movements- Chipko, Green Belt, Navadanya , Women's Land & Water rights impact of India and abroad. Modernization, Industialisation and Technological development.

UNIT V

ECOFEMINISM

Eco Feminism- Popular women Environmentalists- Vandana Shiva, Wangari Muta Maathai, Medha Patker, Bina Agaarwal, Esther Boserup, Menaka Gandhi.

TEXT BOOKS

1. Mary Joy Breton, Women pioneers for the Environment, Forest History Society, 2001.
2. Mehissa Leach, Women, the Environment and Sustainable Development, Spring 1995.

REFERENCE BOOKS

1. Klaus Toepfer, Women and Environment, UNEP, 1999
2. Rosi Braidotti, Women, the Environment and Sustainable development. Towards a Theoretical Synthesis, Zed Books, 1994

ELECTIVE	LIMNOLOGY	L	T	P	C
		3	**0**	**0**	**3**

AIM

The general aim of the course is to give students knowledge in limnology (fresh water Biology), in research or with an applied focus.

OBJECTIVES:

On completion of the course, the student should be able to

- Understand the basic features of structure and function of inland waters, Identification of diverse species knowledge of the most common limnic organisms.
- Dynamics in biogeochemical cycles and evaluate abiotic and biotic factors in aquatic systems.
- Carry out basic sampling methods to analyses in freshwater parameters.
- Understand the range of human impact influencing aquatic ecosystems, critical factor and functions for restoration..

OUTCOMES

- Analyse and evaluate abiotic and biotic conditions in aquatic systems
- Account for structure and dynamics in biogeochemical cycles and organism communities
- Carry out basic sampling and analyses in freshwater field/laboratory systems
- Plan and carry out experiment/field studies
- Present and evaluate experiment/field studies both orally and in writing.

UNIT- I

INTRODUCTION **9**

Introduction to Limnology , lake, Streams- Stream Geomorphology – Origin of Lake and stream -Physical and chemical Properties of water - Characteristics of water, Aquatic Geochemistry and Acidification, brownification- Water movements - Ripples and waves.

UNIT-II
BIOGEOCHEMICAL CYCLES **9**

Hydrologic Cycle, Carbon cycle, Surface Hydrology, oxygen, Phosphorous and Nitrogen cycle -Nutrient dynamics: sizes and shapes of lakes and streams - Dissolved oxygen concentrations, Salt lakes- nitrification, water sterilization with ultraviolet light, and use of chlorine.

UNIT- III

ECOLOGY OF AQUATIC COMMUNITIES: 9

Ecology of aquatic communities- community interactions and community structure - Community change and invasive species- Introduction to population dynamics – Predation and non-predatory interactions- Trophic Cascades in Streams - Freshwater ecosystems : Thermoline- aphotic , euphotic zones, Lentic and Lotic Ecosystems, Stratification. Trophic interactions and eutrophication.

UNIT- IV

AQUATIC BIODIVERSITY 10

Diversity of aquatic organisms - Phytoplankton - Primary and Secondary Production - Gross and Net productivity, food-chains and food-webs; energy flow - Zoo Biology and Zooplankton Ecology of Zooplanktons, Fish and Other Invertebrates. Benthic Algae / Macrophytes, Algal Succession- algal blooms- Benthic Macroinvertebrates -Prokaryotes, Protista, fungi Food-web models Rotifers, annelids and Molluscs.

UNIT-V 8

Limnological statistics- and applied limnology- Paleolimnology -Pollution, Factors, Measures to minimize Pollution – Government and NGO activities, Pollution control Board, APHA-Standard methods for water and waste water.

TEXT BOOKS

1. Wetzel, R.G. 2001. Limnology: Lake and River Ecosystems, Third Edition. Academic Press.
2. Dodds, W.K., M.R. Whiles 2010. Freshwater Ecology: Concepts and Environmental Applications and Limnology.
3. Dodson, Stanley. 2005. Introduction to Limnology. McGraw-Hill Publishing. New York, NY

REFERENCES

1. Reid, George. 2001. Pond Life: A Guide to common Plants and Animals of North American Ponds and Lakes. St. Martin's Press, New York, NY
2. Giller, Paul & Bjorn Malmqvist. 2008. The Biology of Streams and Rivers. Oxford University Press. ISBN: 198549772.
3. J.Kalff (2002) Limnology: Inland Water Ecosystems. Prentice Hall, Upper Saddle River, NJ.
4. Havel, J.E. 2008. Laboratory excercises for Limnology (BIO 56)

ELECTIVE	METABOLIC ENGINEERING	L	T	P	C
		3	**0**	**0**	**3**

AIM

To provide an in-depth understanding of the various aspects of Metabolic engineering.

OBJECTIVES

To understand the concepts of

- Regulation of Biomolecules.
- Synthesis of Primary metabolites.
- Biosynthesis of Secondary metabolites.
- Bioconversions.
- Regulation of Enzyme production.

OUTCOMES

On completion of this course student will have improved ability:

- To describe basic biological concepts and principles.
- To appreciate the different levels of biological organization.
- To understand that biology has a chemical, physical, and mathematical basis and to explain the importance of the scientific method to understand natural phenomena.
- To integrate modern biology with engineering principles

UNIT I **9**

INTRODUCTION

Introduction – Jacob Monod model, Catabolite regulation, Glucose effect, cAMP deficiency, Feed back regulation, Regulation in branched pathways, Differential regulation by isoenzymes, Concerted feed back regulation, Cumulative feed back regulation, Amino acid regulation of RNA synthesis, Energy charge, Regulation, Permeability control passive diffusion, Active transport group transportation.

UNIT II **8**

SYNTHESIS OF PRIMARY METABOLITES

Alteration of feed back regulation, Limiting accumulation of end products, Feed back, Resistant mutants, Alteration of permeability, Metabolites.

UNIT III **9**

BIOSYNTHESIS OF SECONDARY METABOLITES

Precursor effects, Prophophase, Idiophase relationship, Enzyme induction, Feed back regulation, Catabolite regulation by passing control of secondary metabolism, Producers of secondary metabolites.

UNIT IV **10**

BIOCONVERSIONS

Advantages of bioconversions, Specificity, Yields, Factors important to bioconversion, Regulation of enzyme synthesis, Mutation, Permeability, Co-metabolism, Avoidance of product inhibition, Mixed or sequential bioconversions, Conversion of insoluble substances.

UNIT V **9**

REGULATION OF ENZYME PRODUCTION

Strain selection, Improving fermentation, Recognizing growth cycle peak, Induction, Feed back repression, Mutants resistant to repression, Gene dosage.

Total : 45 Hours

TEXT BOOKS

1. Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnil, P., Humphery, A.E. and Lilly, M.D., 1980. Fermentaion and Enzyme Technology. *John Wiley and Sons*.
2. Stanbury, P.F. and Whitaker, A., 1984. Principles of Fermentation technology. *Pergamon Press.*

REFERENCES

1. Stephanopoulas, G., *et al*., 1996. Introduction to Metabolic Engineering – Principles and Methodologies. *Elsevier Science*.
2. Lee, S. Y. and Papoutsakis, E. T., 1998. Metabolic Engineering. *Marcel Dekker*.
3. Nielsen, J. and Villadsen, J., 2007. Bioreaction Engineering Principles. *Springer.*
4. Voit, E. O., 2000. Computational Analysis of Biochemical Systems : A Practical Guide for Biochemists and Molecular Biologist. *Cambridge University Press*.
5. Scheter, T., 2001. Metabolic Engineering. (Advances in Biochemical Engineering, Biotechnology). *Springer*. Vol. 73.
6. Rhodes, P. M. and Stanbury, P. F., 1997. Applied Microbial Physiology Practical Approach. *IRL Press.*
7. Caldwell, D. R., 1995. Microbial Physiology and Metabolism. *Wm.C.Brown.*

ELECTIVE	MATERIAL SCIENCES AND TECHNOLOGY	L	T	P	C
		3	**0**	**0**	**3**

AIM

To study about the Structure and functions of Biomolecules and Biomaterials.

OBJECTIVES

To understand

- The solid crystalline structure and properties of Biomolecules.
- Structure and functional relationship of Proteins and Nucleic acid.
- Techniques to study Biomolecular structure.
- Production and uses of Biomaterials.
- Synthesis and uses of Biopolymers.

OUTCOMES

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively.

UNIT I **10**

BIOMATERIALS

Definition, Classification, Mechanical properties, Visco elasticity, Wound healing, Body responses to implant materials.

Carbohydrates, Modified carbohydrates for biomedical applications, Polydextrose.
Proteins, Collagen, Fibroin their structure and production.
Biopolymers – Definition, Synthesis, Dextrans, Polyhydroxybutyrate (PHB), Polycaprolactone (PCL), Polyphenol resins; Production of a copolymer of PHB and PHV (polyhydrovaleric acid), Biodegradable polymers.

UNIT II **9**

BIOPHYSICAL PROPERTIES

Strong and weak interactions in biomolecules, Dielectric properties of biomolecules, Electronic properties of biomolecules – Conductivity, Photoconductivity and Piezoelectric effect.

Unit cells, Crystal structures (Bravais Lattices), Theoretical density computations, Crystallography and Miller indices.

UNIT III **9**

IDENTIFICATION OF BIOMOLECULES

X-ray crystallography, Plane polarised light, Circular and elliptical polarised light, Definition of Circular Dichroism (CD), Optical, Rotatory Dispersion (ORD) and their comparative studies, Application to biomolecules, Phenomenon of Luminescence, Fluorescence, Phosphorescence.

UNIT IV **9**

CONFORMATIONS OF PROTEINS AND NUCLEIC ACIDS

Conformation of proteins and enzymes, Energy status, Modification of structure, Dynamics of protein folding, Helix coil transformation, Structure in relation to function, Co-operative properties of enzymes. Conformation of nucleic acids, Helix coil transformation, Thermodynamics of DNA denaturation, Changes in nucleic acid structure.

UNIT V **9**

APPLICATIONS OF BIOMATERIALS

Artificial heart, prosthectic, cardiac, limb prosthesis, externally procured limb prosthesis and dental implants, Soft tissue replacements, sutures, percutaneous and skin implants, maxillofacial augumentation, heart tissue replacement implants, fracture fixation devices, joint replacements.

Total : 45 Hours

TEXT BOOKS

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons, 2004. Biomaterial Science – An Introduction to Materials in Medicine. 2nd Edn., *Academic Press*.
3. Park, J.B., 1984. Biomaterials Science and Engineering. *Plenum Press*.

REFERENCES

1.Ratledge, C. and Kristiansen, B., 2001. Basic Biotechnology. 2nd Edn., *Cambridge University Press*.
2.Doi, Y., 1990. Microbial Polyesters. *VCH Weinheim*.
3.Khanna, O. P., 2006. A Text Book of Material Science & Metallury. *Dhanput Rai Publications,* New Delhi.
4.Rolf E. Hommel, 1994. Electronic Properties of Materials. *Narosa Publishing House*, New Delhi.
5.William D. Callister and David G. Rethwisch, 2010. Material Science and Engineering : An Introduction. *John Wiley & Sons*.

ELECTIVE	BIOREACTOR THEORY	L	T	P	C
		3	**0**	**0**	**3**

AIM

To impart more knowledge about Bioreactors.

OBJECTIVES

On completion of the course the students are expected to know about

- Bioreactor Principles.
- Ideal and Non-ideal Bioreactors.
- Optimization.
- Types of Bioreactors.
- Design and Modelling of Bioreactors.

OUTCOMES

- To analyze the principles of design, operation and major components of industrial bioreactors.
- To explain the various aspects of Submerged Liquid Fermentation and Solid State fermentation bioreactors.
- Have knowledge of bioreactors designed for cell culture technologies in biopharmaceutical industries.
- Elucidate the underlying principles of Membrane bioreactors and apply them for related industrial application

UNIT I **9**

BIOREACTOR PRINCIPLES

Definition of Bioreactor, Basic principles of Bioreactor, Classification of bioreactors, heat transfer in bioreactors – stirred liquids, Application of design equation, relationship between heat transfer, cell concentration and stirring conditions.

UNIT II **9**

IDEAL AND NON-IDEAL BIOREACTORS

Analysis of batch, Continuous flow, Fed batch bioreactor, Non-ideal effects

UNIT III **8**

OPTIMIZATION

Optimization of reactor system, Multiphase Bioreactor.

UNIT IV **10**

BIOREACTOR TYPES

Unconventional bioreactors, Hollow fiber reactor, Air lift Bioreactors, Hydrodynamic three phase flow, Perfusion reactor for animal and plant cell culture, Control of bioreactor.

UNIT V **9**

DESIGN AND MODELLING

Bioreactor Modelling and stability anlaysis, Mechanical design of bioreactors.

Total : 45 Hours

TEXT BOOKS

1. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamentals. 2nd Edn., *Mc Graw Hill*.

REFERENCES

1. Trevan, Boffey, Goulding and Stanbury. Biotechnology. *Tata Mc Graw Hill Publishing Co*.
2. Anton Moser. Bioprocess Technology, Kinetics and Reactors. *Springer Verlag*.
3. James M. Lee. Biochemical Engineering. *PHI, USA*.
4. Atkinson. Handbook of Bioreactors.
5. Harvey W. Blanch, Douglas S. Clark. Biochemical Engineering. *Marcel Decker Inc*.
6. Shuler and Kargi, 1992. Bioprocess Engineering. *Prentice Hall*.
7. Scragg A. H., 1991. Bioreactors in Biotechnology, *Ellis Horwood series*.

ELECTIVE	APPLIED BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

AIM

To develop the skills of the student in different areas of Biotechnology and its potential impacts on all areas of biology.

OBJECTIVES

To have a thorough knowledge about

- Transgenic plants, animals and its uses.
- Application of microbes in Industry.
- Gene therapy, Stem cell technology and Tissue engineering.
- Application of Environmental biotechnology.
- Production of recombinant pharmaceutical products.

OUTCOMES

- The students must have deep knowledge within the field of Applied Biotechnology
- The students must have extensive knowledge of biological macromolecules structure and function and be able to use this knowledge in research and development work

UNIT I **8**

PLANT AND ANIMAL BIOTECHNOLOGY

Plant tissue culture and application of transgenics for crop improvement in agriculture, horticulture and forestry, Plantibodies, plastic from plant, Genetically modified soybean, Transgenic animals and its uses.

UNIT II **9**

MEDICAL BIOTECHNOLOGY

Gene therapy – gene delivery methods, New approaches, Applications of stem cell in the treatment for major diseases in reparative medicine, Hematopoietic Stem Cell transplantation, Applications of tissue engineering – reconstruction of connective tissues, epithelial and endothelial surfaces, DNA fingerprinting, DNA based diagnosis of Genetic disease.

UNIT III **9**

BIOPHARMACEUTICAL TECHNOLOGY

Production of recombinant pharmaceutical products – Biotechnology derived products (Therapeutic proteins): Study of hematopoietic growth factor, Interferons and Interleukins, Insulin, Growth hormones, Vaccines and Monoclonal antibody based pharmaceuticals, Recombinant coagulation factors and thrombolytic agents, Somatostatin, Somatotropin.

UNIT IV **9**

BIOPROCESS TECHNOLOGY

Application of microbes in industry – Industrial Processing, recovery, extraction and purification, Production of antibiotics, solvents, organic acids, amino acids, enzymes, vitamins, single cell protein, food substances from brewing and dairy industry.

UNIT V **10**

ENVIRONMENTAL BIOTECHNOLOGY

Use of genetically engineered organisms, bioleaching and its applications in environmental science, Fuel technology – Ethanol and Biogas. Biotechnological applications in waste management, Novel methods for pollution control, Biosensors, Biodegradable plastics, Biotechnology in Pesticide, Tannery and Paper industry.

Total : 45 Hours

TEXT BOOKS

1. Gupta, P.K. , 2015. Elements of Biotechnology. *Rastogi Publications*.

2. Vaidyanath Pratap Reddy and Sathya Prasad, 2004. Introduction to Applied Biology and Biotechnology. 1st Edn., *B. S. Publications.* Hyderabad.

3. Gary Walsh. Biopharmaceutical : Biochemistry and Biotechnology. 2nd Edn., *John Wiley & sons Ltd.*

4. Samuel E. Lynch and Be Roberts J. Geng. Tissue Engineering.

REFERENCES

1. Maulik and Patel, 1996. Molecular Biotechnology Therapeutic Applications and Strategies. *Wiley & Sons*.

2. Cruger, W. and Cruger, A., 2004. Biotechnology : A Text Book of Industrial Microbiology. 2nd Edn., *Panima Publishers*.

3. Kumar, H.D. Modern Concepts and Biotechnology. *Vikas Publication House Pvt. Ltd*.

4. Casida, L.E., 2000. Industrial Microbiology. *New Age International*, Delhi.

5. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey, Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering , *CRC Press*.

6. Sharma, B.K. Environmental Chemistry.

ELECTIVE	PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT	L	T	P	C
		3	**0**	**0**	**3**

AIM

To introduce Process economics and industrial management principles to Biochemical engineers.

OBJECTIVES

The objective of this course is to teach

- Production management.
- Principles of cost estimation.
- Profitability and investment.
- Annual Reports.
- Quality control.

OUTCOMES

On completion of this course you should be able to:

- Analyse, synthesise and design processes for manufacturing products commercially
- Integrate and apply techniques and knowledge acquired in other courses such as thermodynamics, heat and mass transfer, fluid mechanics, instrumentation and control to design heat exchangers, plate and packed columns and engineering flow diagrams
- Use commercial flowsheeting software to simulate processes and design process equipment
- Recognise economic, construction, safety, operability and other design constraints
- Estimate fixed and working capitals and operating costs for process plants

UNIT I **10**

PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION

Planning, Organization, Staffing, Co-ordination, Directing, Controlling, Communicating, Organization as a process and a structure, Types of organizations, Method of study, Work measurement techniques, Basic procedure, Motion study, Motion economy, Principles of time study, Elements of production control, Forecasting, Planning, Routing, Scheduling, Dispatching, Costs and costs control, Inventory and inventory control.

UNIT II **8**

ENGINEERING ECONOMICS FOR PROCESS ENGINEERS – INTEREST, INVESTMENT COSTS AND COST ESTIMATION

Time value of money, Capital costs and depreciation, Estimation of capital cost, Manufacturing costs and working capital, Invested capital and profitability.

UNIT III **9**

PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT

Estimation of project profitability, Sensitivity analysis, Investment alternatives, Replacement policy, Forecasting sales, Inflation and its impact.

UNIT IV **9**

ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE

Principles of accounting, Balance sheet, Income statement, Financial ratios, Analysis of performance and growth.

UNIT V **9**

ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL

Essentials of economic balance – Economic balance approach, Economic balance for insulation, Evaporation, Heat transfer, Elements of quality control, Role of control charts in production and quality control.

Total : 45 Hours

TEXT BOOKS

1. Peters, M. S. and Timmerhaus, C. D., 2002. Plant Design and Economics for Chemical Engineers. *McGraw Hill*. 5th Edn.
2. Narang, G. B. S. and Kumar, V., 1988. Production and Costing. *Khanna Publishers*.

REFERENCES

1. Allen, L.A. Management and Organization. *McGraw Hill*.
2. Perry, R. H. and Green, D. Chemical Engineer's Handbook. *McGraw Hill*. 7th Edn.
3. Holand, F. A., Watson, F. A. and Wilkinson, J. K., 1983. Introduction to Process Economics. *John Wiley & Sons*. 2nd Edn.

4.Harold Koontz, 2004. Principles of Management. 1st Edn., *Tata McGraw Hill*. Rudd and Watson, 1987. Strategy for Process Engineering, *Wiley Publications*.

	CODE	COURSE TITLE	L	T	P	C
ELECTIVE		DISASTER MITIGATION AND MANAGEMENT	3	0	0	3

AIM

The purpose of this course is to provide a knowledge in Disaster Management and create an awareness about disaster preparedness

OBJECTIVE

- To Understand basic concepts in Disaster Management
- To Understand Definitions and Terminologies used in Disaster Management
- To Understand the Challenges posed by Disasters
- To understand Impacts of Disasters

OUTCOMES

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation
- Draw the hazard and vulnerability profile of India, scenarious in the Indian context,
- Disaster damage assessment and management

UNIT 1 INTRODUCTION **9**

Concept of disaster; Different approaches; Concept of Risk; Levels of disasters; Disaster phenomena and events *(Global, national and regional)*; Natural and man-made hazards

UNIT 2 RISK ASSESSMENT AND VULNERABILITY ANALYSIS **9**

Response time, frequency and forewarning levels of different hazards; Characteristics and damage potential of natural hazards; hazard assessment ;Dimensions of vulnerability factors; vulnerability assessment; Vulnerability and disaster risk; Vulnerabilities to flood and earthquake hazards

UNIT 3 DISASTER MANAGEMENT MECHANISM **9**

Concepts of risk management and crisis management ; Disaster management cycle ;Response and Recovery ; Development, Prevention, Mitigation and Preparedness; Planning for relief

UNIT 4 DISASTER RESPONSE **9**

Mass media and disaster management; Disaster Response Plan; Communication, Participation, and Activation of Emergency Preparedness Plan; Logistics Management; Psychological Response; Trauma and Stress Management; Rumour and Panic Management ;Minimum Standards of Relief; Managing Relief; Funding

UNIT 5 DISASTER MANAGEMENT IN INDIA **9**

Strategies for disaster management planning; Steps for formulating a disaster risk reduction plan; Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans

Text books

1. Alexander, D. *Natural Disasters*, ULC press Ltd, London, 1993.
2. Carter, W. N. *Disaster Management: A Disaster Management Handbook,* Asian Development Bank, Bangkok, 1991.
3. Chakrabarty, U. K. *Industrial Disaster Management and Emergency Response,* Asian Books Pvt. Ltd., New Delhi 2007.

References

1. Abarquez I. & Murshed Z. *Community Based Disaster Risk Management: Field Practitioner's Handbook,* ADPC, Bangkok, 2004.
2. Goudie, A. *Geomorphological Techniques,* Unwin Hyman, London 1990.
3. Goswami, S. C. *Remote Sensing Application in North East India,* Purbanchal Prakesh, Guwahati, 1997.
4. *Manual on Natural Disaster Management in India*, NCDM, New Delhi, 2001.
5. *Disaster Management in India*, Ministry of Home Affairs, Government of India, New Delhi, 2011.
6. *National Policy on Disaster Management*, NDMA, New Delhi, 2009.
7. *Disaster Management Act. (2005),* Ministry of Home Affairs, Government of India, New Delhi, 2005.