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

FACULTY OF ENGINEERING AND TECHNOLOGY

REGULATIONS-2012

CURRICULUM AND SYLLABUS

FROM

I TO VIII SEMESTERS

FOR

B.E.BIO TECHNOLOGY ENGINEERING [REGULAR)

I SEMESTER

S.No.	Course Title	Offering Department	L	T	P	C
THEORY						
1	English for Effective Communication	ENGLISH	2	1	0	3
2	Bio Engineering Mathematics-I	MATHS	3	1	0	4
3	Engineering Physics	PHY	2	1	0	3
4	Computer Foundation Program	CSE	2	1	0	3
5	Environmental Science & Engineering	CHE	2	1	0	3
6	Biochemistry- I	BTE	2	1	0	3
PRACTICAL						
7	Engineering Physics Lab	PHY	0	0	4	2
8	Computer Foundation Program Lab	CSE	0	0	4	2
9	Bio Chemistry I Lab	BTE	0	0	4	2
TOTAL						25

II SEMESTER

S.No.	Course Title	Offering Department	L	T	P	C
THEORY						
1	Business English	ENGLISH	2	1	0	3
2	Bio Engineering Mathematics II	MATHS	3	1	0	4
3	Engineering Chemistry	CHEM	2	1	0	3
4	Basic Electrical Engineering & Electronics Engineering	EEE/ECE	2	1	0	3
5	Introduction to Biotechnology	BTE	2	1	0	3
6	Programming in C	CSE	2	1	0	3
PRACTICAL						
7	Engineering Chemistry Lab	CHEM	0	0	4	2
8	Programming in C Lab	CSE	0	0	4	2
9	Basic Electrical & Electronics Engineering Lab	EEE/ECE	0	0	4	2
TOTAL						25

SEMESTER III

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Cell Biology	3	0	0	3
2.		Microbiology	3	0	0	3
3.		Genetics	3	0	0	3
4.		Bio-organic Chemistry	3	0	0	3
5.		Biostatistics	3	1	0	4
6.		Principles of Chemical Engineering	3	1	0	4
PRACTICAL						
7.		Microbiology Lab	0	0	4	2
8.		Bio-organic Chemistry Lab	0	0	4	2
9.		Chemical Engineering Lab	0	0	4	2
		TOTAL	18	2	12	26

SEMESTER IV

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Molecular Biology	3	0	0	3
2.		Enzyme Engineering and Technology	3	0	0	3
3.		Food Biotechnology	3	0	0	3
4.		Analytical Techniques in Biotechnology	3	1	0	4
5.		Instrumental Methods of Analysis	3	1	0	4
6.		Unit Operations	3	1	0	4
PRACTICAL						
7.		Cell and Molecular Biology Lab	0	0	4	2
8.		Instrumental Analysis Lab	0	0	4	2
9.		Professional Communication and Personality Development	0	0	4	2
		TOTAL	**18**	**3**	**12**	**27**

SEMESTER V

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Biochemistry II	3	0	0	3
2.		Immunology	3	0	0	3
3.		Protein Engineering	3	0	0	3
4.		Bioethics, Biosafety and IPR	3	0	0	3
5.		Chemical and Biological Thermodynamics	3	1	0	4
6.		Elective I	3	0	0	3
PRACTICAL						
7.		Biochemistry II Lab	0	0	4	2
8.		Immunology Lab	0	0	4	2
		TOTAL	18	1	8	23

SEMESTER VI

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Genetic Engineering	3	0	0	3
2.		Plant and Animal Biotechnology	3	0	0	3
3.		Principles of Bioinformatics	3	0	0	3
4.		Bioprocess Engineering	3	0	0	3
5.		Mass Transfer Operations	3	1	0	4
6.		Elective II	3	0	0	3
PRACTICAL						
7.		Genetic Engineering Lab	0	0	4	2
8.		Bioprocess Engineering Lab	0	0	4	2
		TOTAL	18	2	8	24

SEMESTER VII

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Genomics and Proteomics	3	0	0	3
2.		Biopharmaceutical Technology	3	0	0	3
3.		Downstream Processing in Biotechnology	3	1	0	4
4.		Nano biotechnology	3	0	0	3
5.		Chemical Reaction Engineering	3	1	0	4
6.		Total Quality Management	3	0	0	3
PRACTICAL						
7.		Down stream processing Lab	0	0	4	2
8.		Comprehension	0	0	4	2
		TOTAL	18	2	10	24

SEMESTER VIII

Sl.No	Course Code	Course Title	L	T	P	C
THEORY						
1.		Elective III	3	0	0	3
2.		Elective IV	3	0	0	3
3.		Elective V	3	0	0	3
PRACTICAL						
4.		Project Work	0	0	12	6
		TOTAL	9	0	12	15

TOTAL CREDITS- 189

LIST OF ELECTIVES

S.No	Subject Name	L	T	P	C
1	ImmunoTechnology	3	0	0	3
2	Cancer Biology	3	0	0	3
3	Molecular Pathogenesis	3	0	0	3
4	Metabolic Engineering	3	0	0	3
5	Concepts in Biotechnology	3	0	0	3
6	Neuroscience	3	0	0	3
7	Bio Conjugate Technology	3	0	0	3
8	Cryopreservation theory and applications	3	0	0	3
9	Stem Cell Biology	3	0	0	3
10	Clinical trials	3	0	0	3
11	Material sciences and technology	3	0	0	3
12	Biological Spectroscopy	3	0	0	3
13	Biophysics	3	0	0	3
14	Molecular Modelling and Drug Design	3	0	0	3
15	Biosensor Principles and Applications	3	0	0	3
16	Bioprocess Economics and Plant Design	3	0	0	3
17	Process Instrumentation Dynamics and Control	3	0	0	3
18	Process Modelling and Simulation	3	0	0	3
19	Bioreactor Theory	3	0	0	3
20	Bioreactor Design	3	0	0	3
21	Environmental Biotechnology	3	0	0	3
22	Bio-Business and Bio-Entrepreneurship	3	0	0	3
23	Process Economics and Industrial Management	3	0	0	3
24	Cyber Security	3	0	0	3
25	Professional Ethics in Engineering	3	0	0	3

I SEMESTER

SEMESTER	CODE	SUBJECT	L	T	P	C
I		ENGLISH FOR EFFECTIVE COMMUNICATION	3	0	0	3

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

OBJECTIVES

- To make the students of Engineering courses learn English for Effective communication
- To make them competent enough in the use of English in todays Global scenerio
- To make our Engineering Graduates fit for any MNC today.

UNIT – I **9**

Word formation with prefixes and suffixes, Antonyms & Synonyms-Tense Forms - Different kinds of Nouns and Pronouns - Use of Verbs and Adverbs – Adjectives - Sentence Pattern (SVOCA) - Conditional Sentences - Auxiliary and Modal verbs – Articles.

UNIT – II **9**

Phonetics (Vowels, Consonants and Diphthongs) - Pronunciation Guidelines - Vocabulary (Homophones).

UNIT – III **9**

Principles of Communication - Defining and Describing Objects - Listening for Information and Making Inferences - Understanding Ideas and Making Inferences.

UNIT – IV **9**

How to write reports, report writing – Recommendations - Discussing data and coming to

conclusions - Rearranging the jumbled sentences.

UNIT – V **9**

Skimming - Scanning – Flowcharts - Pie-charts - Formal and Informal letters - Resume Writing.

Total: 45 hours

OUTCOME:

1. It is hoped that the students who are taught the revised English for Effective communication syllabus will be able to communicate in English.
2. This syllabus will enable our U.G Engineering graduates to face any challenges with confidence and they will prove with their counter part any where in the globe.

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.

BIO-ENGINEERING MATHEMATICS - I
(Common to Biotechnology and Bio informatics)

Aim:

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

Objectives:

The syllabus for the Bio Engineering Mathematics I has been framed catering to the needs of the Bio Engineering students .The basic concepts of Mathematics and Statistics required for application have been introduced.

Outcome:

At the end of this course the students will be in a position to apply the knowledge of Mathematics in Bio Engineering branches.

UNIT – I MATRICES

Basic properties of Matrices – inverse – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values – Cayley-Hamilton theorem(Without proof)-Applications.

UNIT – II 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 – III INTEGRATION

Concept of integratrion-Integration of Rational, Trignometric and Irrational functions – Using Partial Fractions – Substitutions – Integration by parts

UNIT-IV APPLICATION OF INTEGRATION

Concept of Double integration - Cartesian and Polar co-ordinates. Applications of integrations-Areas and Volume of revolution

UNIT – V 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.

Total hours: 60 Lecture Hours: 45Tutorial Hours: 15 Credit: 04

TEXT / REFERENCE BOOKS

1. Bio Engineering Mathematics by Department of Mathematics,VMU
2. N.Subramaniam ., " Engineering Mathematics".,SCM Publishers
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers

SEMESTER	CODE	SUBJECT	L	T	P	C
I		ENGINEERING PHYSICS	3	0	0	3

(Common to all branches of B.E)

OBJECTIVE

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

UNIT – I LASERS **9**

Einstein coefficients (A&B), Nd – YAG laser, CO_2 laser, semiconductor laser (homojunction) – uses of lasers – Holography – construction and reconstruction of a hologram.

UNIT – II 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 (block diagram only) – fibre optic sensors (displacement sensor and pressure sensor).

UNIT – III CRYSTAL PHYSICS **9**

Lattice – unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – calculation of number of atoms per unit cell – atomic radius – coordination number – packing factor for SC, BCC, FCC, HCP structures.

UNIT – IV ACOUSTICS **9**

Classification of sound – characteristics of musical sound – loudness – Weber-Fechner law – decibel – absorption coefficient – experimental determination – reverberation – reverberation time – Sabine's formula (no derivation) – factors affecting acoustics of buildings (reverberation time, loudness, focusing, echo, echolen effect, resonance and noise) and their remedies.

UNIT- V NON – DESTRUCTIVE TESTING **9**

Liquid penetrant method – ultrasonic flaw detection – ultrasonic flaw detector (block diagram) – X-ray Radiography: displacement method – X-ray Fluoroscopy – merits and demerits of each method.

Total: 45 hours

OUTCOME:

Students will gain knowledge in the basic concepts of physics which can be applied in Engineering & Technology

TEXT BOOK

1 Gaur R. K. and Gupta S. L., “Engineering Physics”, Dhanpat Rai publishers, New Delhi, 2001.
2 Rajendran. V, “Engineering Physics”, Tata Mc Graw Hill Publication and Co New Delhi, 2009.

REFERENCE BOOKS

1 Pillai S.O “Solid Sate Physics”, New Age International Publication, New Delhi, (2003).
2 Palanisamy P.K. “Physics for Engineers”, Scitech publications (India) Pvt. Ltd., Chennai (2005).
3 Rajendran V and Marikani “Physics for Engineers”, Tata McGraw Hill Publising Company Ltd, New Delhi (2004).
4 Arumugam M, “Engineering Physics”, Anuradha Agencies, Kumbakonam, Second Edition (2005).

SEMESTER	CODE	SUBJECT	L	T	P	C
I		COMPUTER FOUNDATION PROGRAM	3	0	0	3

(Common to all Branches)

OBJECTIVE:

The proposed course exposes the students to IT Essentials. The Core Modules of this paper includes Programming, Database and Operating system and other related topics.

UNIT I - Basics of Computer and Information Technology **9**

Digital computer fundamentals-Block diagram of a computer-component of a computer system Hardware and software definitions-Categories of software-Booting-Installing and Uninstalling Software-Software piracy-Software terminologies-Application of Computer-Role of Information Technology-History of Internet-Internet Services.

UNIT II - Problem Solving Methodologies and Techniques **9**

Problems solving Techniques-Program development cycle-Algorithm-Design-Flow chart-Program control structures-Types and generation of programming languages-Development of algorithms for simple problems. Top down and Bottom up approaches of software development.

UNIT III - Basics of Computer Architecture and System Software **9**

Fundamentals of Computer Architecture-Introduction-Organization of a small computer Central Processing Unit-Execution cycle-Instruction categories – measure of CPU performance Memory-Input/output devices-BUS-addressing modes.

System Software-Assemblers-Loaders and linkers-Compilers and interpreters.

UNIT IV - Basics of Operating System and DBMS **9**

Introduction-Basics of memory management schemes-Scheduling-threads.

Introduction to File and Database systems- SQL-DDL statements-DML statements-DCL statements.

UNIT V - Software Applications **9**

Office Automation: Application Packages-word processing-Spread sheet Application and Basics of HTML.

Total: 45 hours

OUTCOMES:

At the end of this course, student shall be able to:

Do Problem Solving using Programming and algorithms, Describe working of Internet based applications, Document artifacts using common quality standards, Design simple data store using DBMS concepts and implement, Develop a working website with all above learning.

REFERENCES

1. Ashok N.Kamthane, programming with ANSI and TURBO C, Pearson Education (India) 2005.
2. V.Ramesh babu, fundamental of computing, VRB publisher, 2004.
3. Carl Hamacher, Zvonko Varnesie and Safwat Zaky, 5th Edition "Computer Organization", McGraw-Hill, 2002.
4. Leland L.Beck, "System Software- An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2000.
5. Abraham Silberschatz, Peter Baer Galvin and Greg Gange, "Operating System Concepts", Sixth Edition, John Wiley & Sons Pvt. Ltd,2003.
6. Abraham Silberschatz, Henry F.Korth and S.Sudarshan – "Database Systems Concepts", Fourth Edition, McGraw-Hill, 2002.

SEMESTER	CODE	SUBJECT	L	T	P	C
I		ENVIRONMENTAL SCIENCE AND ENGINEERING	3	0	0	3

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

OBJECTIVE:

It is the branch of science which deals with the effects of human activities &modern technology on environment. It creates awareness among the engineering students about environmental pollution and the role of the engineers in conservation of environment.

UNIT – I - ENVIRONMENT AND NATURAL RESOURCES 9

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

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 9

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

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

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

OUT COME:

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

TEXT BOOKS:

1. Environmental Science and Engineering by Dr. J. Meenambal , MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson Education Pvt Ltd., II Edition, ISBN 81-297-0277-0, 2004
2. Miller T.G. Jr Environmental Science Wadsworth Publishing Co.
3. Townsend C. Harper J. and Michael Begon, Essentials of Ecology, Blackwell Science.

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.

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.

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

OUTCOMES:

The students develops understanding and provides scientific basics of the life processes at the molecular level and explain the structure, function and inter-relationships of biomolecules and their deviation from normal and their consequences for interpreting and solving clinical problems.

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		ENGINEERING PHYSICS LAB	0	0	4	2

AIM

To gain the knowledge of taking precise readings from equipments

OBJECTIVE:

To understand the working principle of various physics equipments

To learn about taking reading precisely

To know about the systematic handling of equipments

(Common to all branches of B. E.)

List of Experiments

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

OUTCOME:

Students will have the knowledge of taking measurements precisely.

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

(Common to all Branches)

AIM:

To understand the Basics of Computer and Information Technology skills and Problem Solving Techniques

OBJECTIVE:

The proposed course exposes the students to IT Essentials. The Core Modules of this paper includes Programming, Database and Operating system and other related topics.

UNIT I - Basics of Computer and Information Technology 9

Digital computer fundamentals-Block diagram of a computer-component of a computer system Hardware and software definitions-Categories of software-Booting-Installing and Uninstalling Software-Software piracy-Software terminologies-Application of Computer-Role of Information Technology-History of Internet-Internet Services.

UNIT II - Problem Solving Methodologies and Techniques 9

Problems solving Techniques-Program development cycle-Algorithm-Design-Flow chart-Program control structures-Types and generation of programming languages-Development of algorithms for simple problems. Top down and Bottom up approaches of software development.

UNIT III - Basics of Computer Architecture and System Software 9

Fundamentals of Computer Architecture-Introduction-Organization of a small computer Central Processing Unit-Execution cycle-Instruction categories – measure of CPU performance Memory-Input/output devices-BUS-addressing modes.

System Software-Assemblers-Loaders and linkers-Compilers and interpreters.

UNIT IV - Basics of Operating System and DBMS 9

Introduction-Basics of memory management schemes-Scheduling-threads.

Introduction to File and Database systems- SQL-DDL statements-DML statements-DCL statements.

UNIT V - Software Applications 9

Office Automation: Application Packages-word processing-Spread sheet Application and Basics of HTML.

Total: 45 hours

OUTCOME:

At the end of this course, student shall be able to:

Do Problem Solving using Programming and algorithms, Describe working of Internet based applications, Document artifacts using common quality standards, Design simple

data store using DBMS concepts and implement, Develop a working website with all above learning

TEXT BOOK

1. Faculties, School of Computer Science, “Computer Foundation Program”, Anuradha Publication, 2012.

REFERENCES

1. Ashok N.Kamthane, programming with ANSI and TURBO C, Pearson Education (India) 2005.
2. V.Ramesh babu, fundamental of computing, VRB publisher, 2004.
3. Carl Hamacher, Zvonko Varnesie and Safwat Zaky, 5th Edition “Computer Organization”, McGraw-Hill, 2002.
4. Leland L.Beck, “System Software- An Introduction to Systems Programming”, 3rd Edition, Pearson Education Asia, 2000.
5. Abraham Silberschatz, Peter Baer Galvin and Greg Gange, “Operating System Concepts”, Sixth Edition, John Wiley & Sons Pvt. Ltd,2003.
6. Abraham Silberschatz, Henry F.Korth and S.Sudarshan – “Database Systems Concepts”, Fourth Edition, McGraw-Hill, 2002.

YEAR	I	BIOCHEMISTRY I LAB	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

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

OUTCOMES

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

II SEMESTER

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

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

OBJECTIVES:

- To make the students understand the principles of basic English Grammar and use it in their day to day life
- To make the Engineering Graduates Employable and Industry ready
- To make our students that they are second to none in the best use of the English language

UNIT – I **9**

Subject and Verb Agreement (Concord) - Active and Passive Voice, Impersonal Passive Voice – Preposition - Common Errors - Direct Speech and Indirect Speech - Cause and Effect - Phrasal Verbs and Idioms and Phrases - Question Tags – Vocabulary.

UNIT – II **9**

Stress (Word Stress and Sentence Stress) – Intonation - Differences in British and American English – Indianism.

UNIT – III **9**

Role Play - Telephonic Etiquettes - Interview Questions (Direct, Open-ended and Closed Questions) - E-mail Netiquette, Sample E-mails.

UNIT – IV **9**

Instruction - Check-list - Minutes of the Meeting and Writing Agenda - Note making.

UNIT – V **9**

Reading Comprehension - Interpreting Tables - Bar charts - Business Letters (Calling for Quotation, Placing Orders and Complaint Letters) - Essay Writing and Developing Hints.

Total: 45 hours

OUTCOME:

1. By teaching this syllabus, it is believed that the UG Engineering graduates will develop their fluency level of using English.
2. Students, who undergo this syllabus, will fulfill the expectations of the industries and find themselves employable in any field.

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.

BIO-ENGINEERING MATHEMATICS - II
(Common to Biotechnology)

Aim:

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

Objectives:

The syllabus for the Bio Engineering Mathematics II has been framed catering to the needs of the Bio Engineering students .The basic concepts of Mathematics and Statistics required for application have been introduced.

Outcome:

At the end of this course the students will be in a position to apply the knowledge of Mathematics in Bio Engineering branches.

UNIT – I COMPLEX NUMBERS

Definition- Examples- Addition-subraction-multiplication and division of complex numbers, simple problems

UNIT-II DESCRIPTIVE STATISTICS

Frequency distribution- measures of central tendency: Mean, Median, Mode- Measures of dispersion: Moments, skewness and Kurtosis

UNIT –III PROBABILITY CONCEPTS

Definitions, sample space, Events, Axioms of probability, Law of addition of probability, Multiplication law and conditional probability, Baye's theorem (without proof)

UNIT -IV CORRELATION, REGRESSION & TEST OF SIGNIFICANCE

Correlation coefficient, Rank correlation – Regression lines. Student't' test, F- test, Chi- square test, Analysis of variance

UNIT –V PROBABILITY DISTRIBUTION

Random variable-Probability density function-distribution function-mathematical expectation-variance-discrete distribution-Binomail, Poission and exponential distributions and their propoerties.

Total hours: 60
Lecture Hours: 45
Tutorial Hours: 15
Credit :04

TEXT / REFERENCE BOOKS:

1. Bio Engineering Mathematics by Department of Mathematics,VMU

2. Dr.A.Singaravelu ," Probability and Random ProcessI", Meenakshi Agency
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers
4. Fundamentals of Mathematical Statistics by S.C.Gupta and V.K.Kapoor.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		ENGINEERING CHEMISTRY	3	0	0	3

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

OBJECTIVE

With a solid foundation in basic scientific and engineering principles, while allowing specialization in Engineering chemistry and ability to assess the impact of engineering solutions in a global and societal context.

UNIT I - WATER TECHNOLOGY & CORROSION 9

Sources of water – impurities – Hardness and its determination (problems to be avoided) – boiler troubles – water softening (zeolite & Demineralisation) – Domestic water treatment – Desalination (Electrodialysis & Reverse Osmosis).

Corrosion – Types – principles – corrosion control methods (Sacrificial and Impressed current method).

UNIT II - ELECTROCHEMISTRY, BATTERIES AND FUEL CELLS 9

Ostwald Law and Debye Huckle's law - Cells – Electrode (SHE, Calomel and Glass) - Electrode potential – Nernst equation – EMF series.

Primary cells – secondary batteries – charging and discharging.

UNIT III - CHEMISTRY OF ADVANCED MATERIALS 9

Portland cement –setting and hardening – RCC – Special cements.

Organic electronic material, solid oxide materials, shape memory alloys, nanomaterials, polymers, fullerenes, ceramics, fibers, lubricants, refractories & composites (definition, classific

ation and applications)

UNIT IV - PHASE EQUILIBRIA & NUCLEAR CHEMISTRY 9

Phase rule: statement and explanation of terms involved – One component system – Condensed phase rule – Two component system.

Nuclear Chemistry – Fission – Fusion – working of nuclear reactor – Radiations and harmful effects.

UNIT V - CHROMATOGRAPHY AND SPECTROSCOPY 9

Chromatography — classification & principles (Paper, column, thin layer, gas, HPLC).

Spectroscopy – Electromagnetic radiation – Beer Lambert's law – UV – Visible – IR (Principle and Instrumentation, block diagram) – Atomic absorption spectroscopy.

Total: 45 hours

OUTCOME:

The student will come out with the ability to assess the impact of engineering solutions.

REFERENCES:

1. Engineering Chemistry by S.S. Dara
2. Engineering Chemistry by Jain & Jain.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

(Common to ECE,ETCE,MECHT,BME,BT,BF,EEE,E&I,CSE,IT, CSSE AND CIVIL)

A) ELECTRICAL ENGINEERING

UNIT I **8**

Electrical Circuits & Meters

Definition of electromotive force, current, power and energy-International System of units-Ohm's law and Kirchhoff's laws-solution of series and parallel Circuits.

Generation of alternating voltage-average and RMS values-solution of simple R,RL,RC and RLC circuits- Calculation of power and power factor in AC circuits.

Construction and principles of operation of moving coil, moving iron and dynamometer instruments.

UNIT II **8**

DC Machines (Qualitative Treatment Only)

Dc machines –parts-DC generator-EMF equation-Different types of DC generators and their applications-DC motors and their applications-different types -speed control-Starters.

UNIT III **7**

AC Machines (Qualitative Treatment Only)

Construction & principle of operation of transformers-Single phase & Three phase transformers-Construction and operation of AC motors-Single phase and three phase Induction motors-applications-construction, principles of operation and application of synchronous motors.

B) ELECTRONICS ENGINEERING

UNIT I: SEMICONDUCTOR DEVICES AND APPLICATIONS **8**

Passive and Active Components – Resistors, Inductors, Capacitors, Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configuration and Characteristics.

UNIT II: FUNDAMENTALS OF COMMUNICATION ENGINEERING **8**

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude Modulation, Angle Modulation, Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Code Modulation

Communication Systems: Radio, High DefinitionTV, MODEM, Fax, Microwave, Radar, Satellite and Optical Fibre, Mobile-Cellphones (block diagram description only).

UNIT III: STUDY OF ADVANCED ELECTRONIC GADGETS **7**

High Definition Camera, High Definition Video Camera, Tablet PC, Android Phones, i pods, Video Game Consoles

Total: 46 hours

OUTCOMES:

- ability to identify the electrical components explain the characteristics of electrical machines.
- ability to identify electronics components and use of them to design circuits.

TEXT BOOKS

1. "Basic Electrical and Electronics Engineering", compiled by Department of EEE&ECE faculty of Engineering & technology, VMRFDU, Anuradha Agencies, 2006.
2. Edward Hughes, "Electrical and Electronics Technology", Pearson Education Limited, Ninth edition,2005.
3. "Basic Electrical and Electronics Engineering", Compiled by Department of EEE & ECE, Faculty of Engineering and Technology, VMRFDU, Anuradha agencies,2006.

REFERENCES

1. B.R. Guptha, "Principles of Electrical Engineering " ,S.Chand & Co,2002.
2. I.J.Nagrath, "Elements of Electrical Engineering", Tata McGraw Hill Publishing Co., 2002.
3. H.Cotton." Advanced Electrical Technology", Wheeler, 1983.
4. Anokh Singh, Principles of Communication Engineering, S.Chand & Co, 1994.
5. John Kennedy "Electronics Communication System" Tata McGraw Hill.
6. Millman and Halkias, "Electronic Devices and Circuits", Tata McGraw hill.
7. V.K.Mehta,"Principles of Electronics"S.Chand&Co,2002
8. http://en.wikipedia.org/wiki/cell-phone
9. http://en.wikipedia.org/wiki/high-definition-video
10. http://en.wikipedia.org/wiki/tablet-components
11. http://en.wikipedia.org/wiki/cell-phone
12. http://en.wikipedia.org/wiki/android-operating -system
13. http://www.apple.com/pad/
14. http://en.wikipedia.org/wiki/ipad
15. http://en.wikipedia.org/wiki/video-game-console
    http://en.wikipedia.org/wiki/video-game-console
    http://en.wikipedia.org/wiki/video-game-console

SEMESTER	INTRODUCTION TO BIOTECHNOLOGY	L	T	P	C
II		2	1	0	3

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

OBJECTIVES
To understand the basic concepts of the following

- Food Biotechnology.
- Agricultural Biotechnology.
- Animal Biotechnology.
- Medical Biotechnology.
- Environmental Biotechnology.

UNIT I **8**

INTRODUCTION

Biotechnology: An overview- What is biotechnology? Biotechnology, an interdisciplinary pursuit, Old and New Biotechnology, Scope and importance, Commercial potential, Public perception of Biotechnology, Biotechnology in India.

UNIT II **10**

GENERAL AND INDUSTRIAL BIOTECHNOLOGY

Isolation and screening of micro organisms, Bioreactors, Process development, Scale up and Media design for Fermentation Process, Food and Beverage Fermentation, Enzymes and Food Processing, Immobilization of enzymes, Biotransformatios, Production of Single cell Protein (SCP), SCP derived from Algae, Wastes, Agricultural crops and Economic implications of SCP, Production of Bioethanol and Biodiesel, Biosensors.

UNIT III **9**

BIOTECHNOLOGY IN AGRICULTURE AND ENVIRONMENT

Biotechnology methods of crop improvement, Plant tissue culture, Transgenesis, Transgenic plants, Applications of Transgenic plants, Transgenic animals, Novel and Better, Bioinsecticides, Biofertilizers. Contributions of Biotechnology in Waste water Treatment and Environment Management, Biodegradation of Xenobiotic Compounds.

UNIT IV **9**

PROCESS TECHNOLOGY AND MICROBIAL PRODUCTION

Perocess Technology for the Production of Cell Biomass and some Primary Metabolites, e.g. Ethanol, Acetone-Butanol and citric acid. Microbial production of industrial enzymes-Glucose isomerase, cellulose etc., Production of secondary metabolites-Pencillin, Tetracycline etc. Production of Vaccines.

UNIT V **9**

BIOTECHNOLOGY IN HUMAN WELFARE AND ETHICS

Conventional vaccines, Recombinant vaccines, DNA vaccines, Monoclonal Antibiodies and Detection of Genetic Diseases, Interferons, Drug designing, Gene theraphy, Forensic Medicine applications of Human Genetic Research. Biotechnology: Legal aspects-Genetically manipulated organisms and Environment, Biosafety, Social, Moral and Ethical consideration.

Total : 45 Hours

OUTCOMES:

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

- To understand the production of bioproducts and methods to improve modern biotechnology.
- To apply basic biotechnological principles, methods and models to solve biotechnological tasks.
- To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.
- To design and deliver useful modern biotechnology products to the Society.

TEXT BOOKS

1. Kumar, H.D. Modern Concepts and Biotechnology. *Vikas Publishing House Pvt. Ltd.*
2. Gupta, P.K. Elements of Biotechnology. *Rastogi Publications.*
3. Jogdand, S.N., 2003. Environmental Biotechnology. *Himalaya Publishing House.*
4. Satyanarayana, 2005. Biotechnology.

REFERENCES

1. John E. Smith. Biotechnology. *Cambridge Press*. 3rd Edn.

2. Glazer, A. and Noickaido, 1995. Microbial Biotechnology-Fundamentals of Applied Microbiology.
3. www.techport.ac.uk/tud/bd/univpo.

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

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

OBJECTIVES :

To enable the student to learn programming knowledge in C.

UNIT I **9**

Introduction: Algorithms & flowcharts-Overview of C-Features of C-IDE of C Structure of C program-Compilation & execution of C program-Identifiers, variables, expression, keywords, data types, constants, scope and life of variables, local and global variables. Operators: arithmetic, logical, relational, conditional and bitwise operators-Special operators: size of () & comma (,) operator-Precedence and associativity of operators & Type conversion in expressions.

Basic input/output and library functions: Single character input/output i.e. getch(), getchar(), getche() & putchar()-Formatted input/output: printf() and scanf()-Library Functions: concepts, mathematical and character functions.

UNIT II **9**

Control structures: Conditional control-Loop control and Unconditional control structures.

Functions: The Need of a function-User defined and library function- Prototype of a function-Calling of a function-Function argument-Passing arguments to function- Return values-Nesting of function- main()-Command line arguments and recursion. Storage class specifier – auto, extern, static, & register.

UNIT III **9**

Arrays: Single and multidimensional arrays-Array declaration and initialization of arrays-Array as function arguments.

Strings: Declaration-Initialization and string handling functions.

Structure and Union: Defining structure-Declaration of structure variable-Accessing structure members-Nested structures-Array of structures-Structure assignment-Structure as function argument-Function that returns structure- Union.

UNIT IV **9**

Pointers: The '&' and * operators-Pointers expressions-Pointers vs arrays-Pointer to functions-Function returning pointers-Static and dynamic memory allocation in C.

DMA functions: malloc(), calloc(), sizeof(), free() and realloc()-Preprocessor directives.

UNIT V **9**

File management: Defining, opening & closing a file, text file and binary file-Functions for file handling: 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: 45 hours

OUTCOMES:

Do develop the skill of the student to develop the programming in C language.

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. Stevens , 'Graphics programming in C', BPB publication, 2006
5. Subbura.R , 'Programming in C', Vikas publishing, 1st Edition, 2000

SEMESTER	CODE	SUBJECT	L	T	P	C
II		ENGINEERING CHEMISTRY LAB	0	0	3	2

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

OBJECTIVE

To learn the relevant experience using laboratory experiments

1. Estimation of total hardness of water sample by EDTA method.
2. Determination of alkalinity by indicator method.
3. Estimation of ferrous ion by Potentiometry.
4. Titration of strong acid with strong base by Conductometry.
5. Acid base reaction by pH metry.
6. Estimation of copper from its ore.
7. Estimation of iron by spectrophotometer.
8. Estimation of sodium by flame photometer.

OUTCOME

The student will have the experience in handling the instruments relevant to his/her theory.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		PROGRAMMING IN C LAB	0	0	3	2

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

AIM

To practice and develop applications using C Programming languages.

OBJECTIVE

To make the students to develop program in C languages.

1. Implementation of Sine and cosine series.
2. Generation of Fibonacci series.
3. To find the i) Factorial number.
   ii) Sum of n natural numbers.
4. Reversing the digits of an integer
5. Conversion of decimal number to octal number
6. Conversion of character integer to decimal number
7. Finding the square root of a given number by applying algorithm
8. (a) Find GCD of two numbers
   (b) Generate Prime numbers between 1 and n.
9. Greatest of three numbers using if statement and conditional operator.
10. Read two numbers and swap those two numbers using temporary variable and without using temporary variable.
11. Quadratic equation for different sets of inputs.
12. Use of switch….Case statements.
13. Matrix operations
    a. Addition
    b. Transpose
    c. Multiplication
14. Ascending and Descending order.
15. Given a set of n numbers, find the length of the longest monotone increasing subsequence.
16. Sort by exchange, selection and partitioning method
17. Use of pointers and array of pointers
18. Linear search.

19. Binary search.
20. Files operations.

OUTCOME:

At the end of the course, the students will be able to develop applications using C Programming languages.

SEMESTER	CODE	SUBJECT	L	T	P	C
II		BASIC ELECTRICAL AND ELECTRONICS LAB	0	0	3	2

(Common to ECE,ETCE,MECHT,BME,BT,BF,EEE, EIE,CSE,IT,CSSE AND CIVIL)

a) ELECTRICAL ENGINEERING LAB

LIST OF EXPERIMENTS

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

b) ELECTRONICS ENGINEERING LAB

1. Familiarization with Electronic Components like R, L, C and active devices.
2. Familiarization with Bread board, CRO, Power supply (RPS, FPS) and Soldering Practice.
3. Generation of lissajous patterns using CRO.
4. Measurement of amplitude and time period using CRO.
5. Study of the Characteristic of PN-Junction diode with its applications.
6. Study of the Characteristic of Zener diode with its applications
7. Study of the rectifier circuits (Half wave and Full Wave) with its applications.
8. Study of BJT Characteristics with its applications.
9. Study of AM/FM Receiver.
10. Study of advanced electronic gadgets.

OUTCOME:

- ability to fabricate electrical and electronics circuits

III SEMESTER

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

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 extensive knowledge on

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

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, Cytoskeletal proteins, Types of cell functions, Cell division, 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 ATP dependent proton pumps, Co-transport, Uniport, Symport, Antiport, Transport into prokaryotic cells, 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.

Total : 45 Hours

OUTCOMES

Upon completion of this course, the students

- Would have deeper understanding of cell at structural and functional level.
- Would have broad knowledge on the molecular interaction between cells.
- Would demonstrate a clear understanding of the signal transduction, secondary messengers.
- Would develop skill on working principles of microscopy and identification of cell types.

TEXT BOOKS

1. De Robertis and De Robertis. Cell Biology. 8th Edn., *B.I. Publications Pvt. Ltd.*
2. James D. Watson. Molecular Biology of the Cell.
3. Verma, P.S. and Agarwal, V.K. Cell and Molecular Biology.

REFERENCES

1. Darnell J. Lodish, Baltimore, H. and Freeman, D., 1990. Molecular Cell Biology. *W. H. Freeman and Company.*
2. Kimball, T.W., 1989. Cell Biology. *Addision Wesley Publishers*.
3. James D. Watson. Molecular Biology of the Cell.
4. Geoffrey M. Cooper and Robert E. Hausman, 2007. The Cell : A Molecular Approach, 4th Edn., *ASM Press and Sinauer Associates Inc.*,USA.
5. 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 microorganisms, 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 of 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 environmental applications.

UNIT I **9**

WORLD OF MICRORGANISMS AND MICROSCOPY

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

UNIT II **8**

STRUCTURAL ORGANISATION AND REPLICATION OF MICROORGANISMS

General structural organisation of bacteria and viruses, Characteristics of microorganisms, Differentiation and development, Multiplication of bacteriophages, Eukaryotic microorganisms such as Yeast – Cellular organization and reproduction.

UNIT III **8**

MICROBIAL NUTRITION AND ENVIRONMENT

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

UNIT IV **10**

FOOD AND CLINICAL MICROBIOLOGY

Food poisoning, Food spoilage and Food preservation, Beneficial microorganisms and products, Clinically important microorganisms and their effects on infections and immunity,

Formation of toxic materials by microorganisms and their role in clinical microbiology.

UNIT V **10**

CONTROL OF MICROORGANISMS AND ITS ENVIRONMENTAL APPLICATIONS

Drug, Chemotherapy, Antimicrobial agents and disinfectants, Diseases caused by microorganism and control, Ecology – Recycling of biomaterials, Production of biogas, Leaching of ores by microorganisms, Microbial indicators, Biofouling, Microbes in Air, Drinking water and Waste water, Polution control through use of consortium of microorganisms.

Total : 45 Hours

OUTCOME

At the end of the course, the students will have sufficient scientific understanding of bacteria and viruses and diseases caused by them.

TEXT BOOKS

1. Pelzar, M.J., Chan, E.C.S and Krieg, N.R. 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. Foundation 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 Hil Book Co.*, New York.
4. George, J.B., 1987. Basic Food Microbiology. *CBS Publishers and Distributors.*
5. James, M.J., 1987. Modern Food Microbiology. *CBS Publishers and Distributors.*

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

AIM

The course is aimed to make the student knowledgeable about the basic concepts of Genetics

OBJECTIVES

- To understand the basic concept of Classical genetics through Mendelian experiment.
- To study the Structural organisation of chromosome.
- To know the Genetical disorders with reference to alleles.
- To impart knowledge on Linkage and crossing over.
- To learn the mechanism of Genetic transfer.

UNIT I **9**

BASIC OF GENETICS

Classical genetics, Mendelian laws, Mendel's experiment monohybrid and dihybrid inheritance.

UNIT II **9**

KARYOLOGY

Chromosome structure and organisation in prokaryotes and eukaryotes, Giant chromosome – Polytene and Lampbrush chromosome.

UNIT III **9**

ALLELES

Classical concept of allelomorphism – Problems, Multiple alleles, Sex linkage in Drosophila, Sex linked lethal 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**

GENETIC TRANSFER

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

Total : 45 Hours

OUTCOMES:

- 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.
- The students would be aware of microarrays, Analysis of Gene expression

TEXT BOOKS

1. Verma, P.S. and Agarwal, V.K., 2005. Genetics. *S. Chand Publication.*
2. Winter, P.C., Hickey, G.I. and Fletcher, H.L., 2003. Instant Notes in Genetics. 2nd Ed., *Viva Book Pvt. Ltd.*

REFERENCES

1. Goodenough, U., 1985. Genetics. *Hold Saunders International*.
2. Gardner, E.J., Simmons, M.J. and Slustad, D.P., 1991. Principles of Genetics.
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., 2000. Principles of Genetics. 2nd Edn., *John Wiley & Sons.*

YEAR	II		L	T	P	C
SEMESTER	III	BIO-ORGANIC CHEMISTRY	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 biological systems.

UNIT I **8**

INTRODUCTION TO BIO-ORGANIC CHEMISTRY

Basic Considerations – Proximity effects in Organic chemistry – Molecular recognition and the supramolecular systems – Ion channels – Catalytic antibodies – Ribosomes.

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, Peptide synthesis – Non-ribosomal and Solid state peptide synthesis, Asymmetric synthesis of amino acids – Retrosynthetic analysis, Transition state analogues.

UNIT III **9**

ENZYME CHEMISTRY

Introduction to catalysis – Mut ifunctional, Acid - base and Covalent catalysis, Introduction to enzymes – α - 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, Membrane chemistry and micelles, Enzyme design using steroid templates – Remote functionalisation reaction – Biomimetic polyene cyclisations, 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, Copper ion, Biomodels for photosynthesis and energy transfer, Cobalt and Vitamin B_{12} actions.

Total : 45 Hours

OUTCOMES

On completion of this course, the students will learn the basics principles of chemical Bonding, Stereochemistry of Bio-organic molecules and their kinetics, mechanisms of reactions and catalysis.

TEXT BOOKS

1. Zubay, G., 1987. Biochemistry. 2nd Edn., *Maxwell Macmillan International Editions.*
2. Dugas, H., 1989. Bio-organic Chemistry – A Chemical Approach to Enzyme Action. *Springer Verlag.*

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 Science : A Guide to Enzyme Catalysis and Protein Folding. *W. H. Freeman*.

BIO-STATISTICS

B.E (Bio Technology& Bio Informatics)

(III SEMESTER)

(Statistical table permitted for examination)

Aim:

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

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:

- To impart analytical ability in solving Mathematical problems as applied as the respective branches of Engineering.

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. **Total Hours : 60**

Tutorial : 15 Credits: 04

Text Book

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 Limited.

YEAR	II	PRINCIPLES OF CHEMICAL ENGINEERING	L	T	P	C
SEMESTER	III		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.

UNIT I **10**

STOICHIOMETRY

Introduction, Units and dimensions, Stoichiometric pr inciples, 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. Material balances with chemical reactions – Limiting reactant, Excess reactant, Recycling and bypass.

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, Latent heat – Heat of formation, Reaction, Mixing, Combustion, Heat capacity, Mean specific heat, 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

OUTCOMES

Upon completion of this course the student will

- Have knowledge on the basic principles of chemical engineering
- Be able to apply the skill of material balance and energy balance in unit operations unit process of chemical engineering and biotechnology
- Be able to analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives
- Understand the design and working principles of fluid moving machinery and transport phenomena

TEXT BOOKS

1. Bhatt, B.I. and Vora, S.M., 1977. Stoichiometry. 3rd Edn., *Tata McGraw Hill.*
2. Anantharaman. Process Calculation.

REFERENCES

1. Himmelblau, D., 1994. Basic Principles and Calculations in Chemical Engineering.. 5th Edn., *Prentice Hall India Ltd.,* India.
2. McCabe, W.L., Smith, J.C. and Harriot, P., 1993. Unit Operations in Chemical Engineering. 5th Edn., *McGraw Hill Inc*.
3. Hougen, O.A. and Watson, K.M. Chemical Process Principles. Vol-I, *CBS Publication.*
4. Geankoplis, C.J., 2002. Transport Processes and Unit Operations. *Prentice Hall India.*
5. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.

YEAR	II		L	T	P	C
SEMESTER	III	MICROBIOLOGY LAB	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.

EXPERIMENTS

1. Sterilisation Techniques.
2. Culture Media Preparations
    a. Broth type 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 Micro organisms
    a. Staining techniques
        - Simple
        - Gram
        - Spore
        - Hanging drop
    b. Biochemical testing

7. Quantitation of Microorganisms

    a. Microscopy and micrometry
    b. Dry weight
    c. Serial dilution plating

8. Environmental Sample Analysis

   - Quantitative estimation of Pathogenic and non-Pathogenic Micorbes from Sewage and Soil samples.

9. Food Microbiology

   - Milk
   - Fermented food

10. Clinical Microbiology

   - Blood and Urine Culture
   - Antibiotic Disc test Assay.

OUTCOMES

The student would learn the knowledge to

- Identify, explain function, and use common culture media properly
- Identify unknown bacteria using biochemical and immunologic testing.
- Explain and perform ELISA test; explain function and usage of a Western Blot test.
- Understand and explain causes of mutations in microbes.
- Demonstrate the use of chemical and physical control of microbes.

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		L	T	P	C
SEMESTER	III	BIO-ORGANIC CHEMISTRY LAB	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 Amine acids.

EXPERIMENTS

1. Synthesis of Aspirin
2. Hydrolysis of Sucrose
3. Preparation of Pyruvic acid from Tartaric acid.
4. Preparation of Oleic acid
5. Carbohydrate Interconversions
    a. Preparation of alpha-D-glucopyranose penta acetate
    b. Preparation of 1,2,5,6 di- O-Cyclohexylidine-alpha-D-glucofuranose.
6. Preparation of Lycopene from Tomato paste
7. Preparation of l-Proline.
8. Preparation of l-Cystine from hair.
9. Preparation of s-ethyl hydroxybutonate from ethyl acetoacetate using Yeast.
10. Preparation of s-ethyl hydroxybutonate using 3,5 dinitrobenzoate.

OUTCOMES

After having completed the course, the student should be able to

- 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
- correlate the chemical structure of biomolecules to reactivity
- 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
- give examples of how chemical properties and reactivity can influence environmental and economical decisions
- discuss appropriate chromatographic methods for determination of organic compounds
- plan and carry out laboratory work in a correct and safe manner and carry out simpler risk and security assessments

REFERENCE

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

YEAR	II	CHEMICAL ENGINEERING LAB	L	T	P	C
SEMESTER	III		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.

LIST OF EXPERIMENTS

1. Flow measurement.
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. Adsorption equilibrium.
10. Jaw crusher.
11. Determination of Screen effectiveness.
12. Sedimentation.

OUTCOMES

Upon completion of this practical course the student will

- Have knowledge on the basic principles of chemical engineering
- Be able to apply the skill of material balance and energy balance in unit operations unit process of chemical engineering and biotechnology
- Be able to analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives
- Understand the design and working principles of fluid moving machinery and transport phenomena

REFERENCE

1. Laboratory Manual.

IV SEMESTER

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.

UNIT I **10**

NUCLEIC ACIDS AND DNA REPLICATION

Nucleic acids – Primary, Secondary and Tertiary structures, Extra chromosomal DNA, Replication in prokaryotes and eukaryotes – Different modes of replication, Complex replication apparatus, Inhibitors of replication, DNA polymorphism, Single Nucleotide Polymorphism (SNPs).

UNIT II **8**

TRANSCRIPTION

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, Deciphering of the genetic code, Colinearity of gene and polypeptide, Structure and functions of ribosomes, Translation mechanism, Post translational modifications, Protein folding.

UNIT IV **9**

REGULATION OF GENE EXPRESSION

Gene regulation – Operons : Lac, trp, ara and gal, Lamda phage life cycle and gene regulation.

UNIT V **8**

MUTAGENESIS AND REPAIR

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

mechanism.

OUTCOMES:

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

- Describe the basic structure and biochemistry of nucleic acids and proteins and discriminate between them.
- 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.

TEXT BOOKS **Total Hours : 45**

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	0	0	3

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.

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, Opt ical and Potentiometric biosensors, Applications of biosensors.

Total Hours : 45

OUTCOMES

The students will be able to

- Classify enzymes and enzymatic reactions towards various concepts in biotechnology.
- Apply the theoretical and practical aspects of reaction kinetics of enzyme substrate reaction
- Examine various enzyme kinetics and enzyme inhibition models
- Summarize methods of extraction and purification of enzymes
- Formulate the concepts of enzyme immobilization and its applications in food, pharmaceutical and chemical industries
- Design of biosensors and its applications in various industries

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.*
2. Cornish-Bowden, A., 1996. Analysis of Enzyme Kinetic Data. *Oxford University Press.*
3. Wiseman, A., Blakeborough, N. and Dunnill, P., 1981. Enzymatic and Nonenzymatic catalysis. Vol. 5, *Ellis and Harwood*, UK
4. Wiseman, A. Topics in Enzyme and Fermentation Biotechnology. Vol.5 *Ellis and Harwood*, UK.

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

YEAR	II	FOOD BIOTECHNOLOGY	L	T	P	C
SEMESTER	IV		3	0	0	3

AIM

To get knowledge in the field of Food process technology and its applications.

OBJECTIVES

To understand the role of

- Biomolecules in food.
- Food additives in food processing.
- Microorganism in food fermentation.
- Microorganism in food spoilage.
- Microorganism in food preservation.

UNIT I **9**

FOOD AND ENERGY

Constituents of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Dietary sources, Role and functional properties in food, Contribution to organoleptic and textural characteristics, Biotechnology in relation to the food industry.

UNIT II **9**

FOOD ADDITIVES

Classification, Intentional and non-intentional additives, Functional role in food processing – Meat, Fisheries, Vegetables, Food colourants – Natural and Artificial, Food flavours, Enzymes as food processing aids.

UNIT III **9**

MICROORGANISMS ASSOCIATED WITH FOOD

Bacteria, Yeast and Molds – Sources, Types and Species of importance in food processing and preservation, Fermented foods – Dairy products, Meat, fishery, Non-beverage plant products, Beverages and Related products, Single cell protein.

UNIT IV **9**

FOOD BORNE DISEASES

Classification, Food infections – Bacterial and other types, Food intoxications and poisonings – Bacterial and non-bacterial, Food spoilage – Factors responsible for spoilage, Spoilage of vegetable, Fruit, Meat, Poultry, Beverage and Other food products.

UNIT V **9**

FOOD PRESERVATION

Principles involved in the use of sterilization, Pasteurization and Blanching, Thermal death curves of microorganisms, Canning, Frozen storage – Freezing characteristics of foods, Microbial activity at low temperatures, Factors affecting quality of foods in frozen storage, Irradiation preservation of foods.

Total : 45 Hours

OUTCOMES

Through this subject the student can understand about

- Different constituents present in food and microorganism involved in processing of food.
- Principles and different preservations techniques of food can also be known.
- Unit operations in modern food processing and impact of the process on food quality

TEXT BOOKS

1. Coultate, T.P., 1992. Food – The Chemistry of Its components. 2nd Society, London.

2. Sivasankar, B., 2002. Food Processing and Preservation, *Prentice Hall of India Pvt. Ltd*., New Delhi. Edn., Royal

REFERENCES

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., *McGraw Hill*
2. *Book Co.*, New York.
3. Jay, J.M., 1987. Modern Food Microbiology, *CBS Publications*, New Delhi.
4. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food
5. Industry. *Willis Elsevier.*
6. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology.
7. George, J.B., 1987. Basic Food Microbiology. *CBS Publishers and Distributors.*
8. James, M.J., 1987. Modern Food Microbiology. *CBS Publishers and Distributors.*

YEAR	II	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	L	T	P	C
SEMESTER	IV		3	1	0	4

AIM

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

OBJECTIVES

- To introduce the basic principles of Chromatographic techniques.
- To impart knowledge on the principles, instrumentation and applications of all Chromatographic techniques.
- To study in detail the different types of Centrifugation and its uses.
- 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.

UNIT I **10**

INTRODUCTION

Classification of techniques, Paper and column chromatography, Distribution coefficients, Retention chromatography, Sorption mechanisms, Retention parameters, Factors affecting retention, Qualitative and quantitative aspects of chromatography, Peak shape sorption isotherms, Column efficiency, Band broadening process, Selectivity and resolution.

UNIT II **8**

CHROMATOGRAPHIC TECHNIQUES

Ion exchange, Size exclusion, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas chromatography – Mass spectroscopy, Chiral chromatography.

UNIT III **9**

CENTRIFUGATION TECHNIQUES

Principles of centrifugation, Instrumentation, Preparative centrifugation – Differential centrifugation, Density gradient, Rate zonal centrifugation, Isopycnic centrifugation, Analytical centrifugation.

UNIT IV **8**

ELECTROPHORETIC TECHNIQUES AND DNA ANALYSIS

Electrophoresis of Proteins and Nucleic acids, 1D and 2D Gels, Pulsed – Field electrophoresis, Capillary electrophoresis, Western Blotting, Gel Documentation, DNA

Purification, PCR – Based analysis, DNA Finger Printing.

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 dry weight and Biomass composting, Analysis of substrate uptake and product formation rates, Measurement of BOD and COD in waste waters, Gas analysis for O_2 and CO_2, Flow injection analysis.

Tutorial : 15

Total : 60 Hours

OUTCOMES

On completion of this course, students will have the skill and knowledge to:

- Understand the basics of the major analytical techniques including sample preparation, standardisation and data analysis for each technique.
- Evaluate strengths and weakness of different analytical techniques for different applications.
- Design an analytical regimen to obtain data relevant to their research proposal.
- Process data sets produced from some instruments. Report in detail on a chosen technique and on analysis of the data.

TEXT BOOKS

1. Sewell, P.A. and Clarke, B., 1991. Chromatographic Separations. *John Wiley and Sons.*
2. Lindsay, B., 1991. High Performance Liquid Chromatography. *John Wiley and Sons.*
3. Srivastava, V.K. and Kishore, K., 1991. Introduction to Chromatography – Theory and Practice. *S. Chand and Company Ltd.,* India.
4. Chatwal and Anand, 2000. Instrumental Methods of Analysis.
5. Upadhyay, Upadhyay and Nath. Himalaya Publishing House.

REFERENCES

1. Lecture Notes on Short Course on Enantiomeric Separations. April 28 – 29, 1995.
2. Henner Schmidt-Traub, 2005. Preparative Chromatography. *John Wiley and Sons.*
3. Freeman, W.H. 1985 – 1993. Reading in Scientific American.
4. Wilson, K. And Walker, J., 2000. Principles and techniques of practical biochemistry. 5^{th} Edn., *Cambridge University Press.*
5. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods

of Analysis. *CBS Publishers and Distributors*.

YEAR	II	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
SEMESTER	IV		3	1	0	4

AIM

To familiarize the students with various instruments that are applied in the field of Biotechnology.

OBJECTIVES

To study in detail about the

- Flame photometry, turbidimetry and nephelometry.
- Optical instruments.
- Molecular spectroscopy.
- Thermal and X - ray methods.

UNIT I **9**

BASICS OF MEASUREMENTS AND SCATTERING OF RADIATION

Classification and calibration of instrumental methods, Rayleigh scattering, Scattering of gases, Atomization, Flame atomization, Turbidimetric and Nephelometric titrations.

UNIT II **9**

OPTICAL METHODS

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

UNIT III **9**

MOLECULAR SPECTROSCOPY

Measurement of transmittance and absorbance, Beer's law, Spectrophotometer analysis, Types of spectrometers, UV – Visible – IR- Raman spectroscopy – Instrumentation – theory, NMR spectroscopy, Auger electron spectroscopy and Atomic absorption spectroscopy.

UNIT IV **9**

THERMAL METHODS

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

UNIT V **9**

X-RAY METHODS

The absorption of X-rays, Monochromatic X-ray sources, X-ray detectors, X-ray diffraction, X-ray fluorescence.

Tutorial : 15
Total : 60 Hours

OUTCOMES

On completion of the course, students will have

- Better understanding of spectroscopy.
- Separation techniques used for biological products.

TEXT BOOKS

1. Willard and Merrit, H., 1999. Instrumental Methods of Analysis. *CBS Publishers*.
2. Chatwal and Anand. Instrumental Methods of Analysis.
3. Skoog, D., 2000. Instrumental Methods of Analysis.

REFERENCES

1. Ewing, G.W., 1989. Instrumental Methods of Chemical Analysis. *McGraw Hill Book Company*.
2. Braun, H., 1987. Introduction to Chemical Analysis. *McGraw Hill Book Company*.
3. Dinesh Kumar Chatanta and Prahlad Singh Mehra, 2012. Instrumental Methods of Analysis in Biotechnology. I K International Publishing House.
4. Hobart H. Willard, Lynne L. Merrit, John, A. and Frank A. Settle, 1981. Instrumental Methods of Analysis. *Van Nostrand*.
5. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, *Benjamin Cummins and Company*.

YEAR	II	UNIT OPERATIONS	L	T	P	C
SEMESTER	IV		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.

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 condestation, 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

OUTCOMES

After completing the course the student would be able to

- Capable of working with simple reactions and sizing simple bioreactors.
- Proficient in Energy Balances for simple processes
- Adept in Material Balances for simple processes
- Carry out basic bioprocess engineering calculations and Processes and Process Variables
- Skilled in the calculation of the performance of simple separation systems.
- Have fundamental understanding of typical plant equipment and their operation

TEXT BOOKS

1. Christie J. Geankoplis. Transport Processes and Unit Operations. *Prentice Hall India Pvt. Ltd.,* 3rd Edn.
2. McCabe, W.L. and Smith, J.C. 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 AND 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 Cell culture and cell identification. This will serve as a prerequisite for Post graduate and specialized studies and Research.

OBJECTIVES

- At the end of the course from various sources, the students would have learnt the methodology to isolate cells and to identify them by specialized Microscopy. This will be extremely beneficial to take up project work in Cellular biology.
- 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.

LIST OF EXPERIMENTS

1. Introduction to principles of sterile 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, MTT Assay, Alamar blue assay
7. Osmosis and Tonicity
8. Staining for different stages of mitosis in *Allium cepa* (Onion)
9. Isolation of DNA – Isolation of plant cell, bacterial and animal cell genomic DNA
10. Quantification of RNA / DNA by physical and chemical method
11. Agarose gel electrophoresis
12. Formaldehyde gel electrophoresis of RNA
13. Plating of O phage
14. O phage lysis of liquid cultures.

OUTCOMES

This practical course will facilitate the students

- To understand the basic techniques to work with cells
- To demonstrate working principles of Microscopy
- To understand and perform cell staining techniques
- 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.
- Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

REFERENCES

1. Sambrook *et al.,* Molecular cloning – A laboratory manual.
2. Laboratory Manual

YEAR	II	INSTRUMENTAL ANALYSIS LAB	L	T	P	C
SEMESTER	IV		0	0	4	2

AIM

To make the students specialised in handling the various instruments of Biotechnological processes.

OBJECTIVES

- At the end of this course, the student would have learnt about the Spectroscopy, Nephelometry and Chromatography. This will be helpful in doing some specialised projects.

EXPERIMENTS

1. Validating Lambert – Beer's law using $KMnO_4$.
2. Precision and Validity in an experiment using Absorption spectroscopy.
3. Finding the Stoichiometry of the Fe (1,10 Phenanthroline Complex) using Absorption spectroscopy.
4. Finding the pKa of 4 Nitrophenol using Absorption spectroscopy.
5. UV spectra of Nucleic Acid.
6. Estimation of Alizarin Aluminium complex, limits of detection.
7. Estimation of Al^{3+} concentration using Alizarin in the spectrometer.
8. Estimation of Sulphate by Nephelometry.
9. Estimation of trace elements by Flame photometer.
10. Experiments on
    a. pH Meter
    b. Conductivity meter
    c. Turbidity meter.
11. Estimation of Dissolved oxygen.
12. Operating principles of IR spectrum of Hydrocarbons (Demo).
13. Operating principles of TGA, DSC and DTA (Demo).
14. Operating principles of NMR and ESR (Demo).

OUTCOMES

The students would understand to

- Visualize and interpret the theory of spectroscopic methods by hands on experiments.
- Explain different types of Instrumental methods.
- Understand spectrometry methods of chemical analysis

- Differentiate among molecular absorption, atomic absorption and atomic emission spectrometry

REFERENCES

1. Laboratory Manual.

SEMESTER	CODE	COURSE TITLE	L	T	P	C
V		PROFESSIONAL COMMUNICATION AND PERSONALITY DEVELOPMENT	0	0	4	2

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)

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

V SEMESTER

YEAR	III	BIOCHEMISTRY II	L	T	P	C
SEMESTER	V		3	0	0	3

AIM

To study the metabolic pathways and its significance in Biochemistry. This 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

- Carbohydrates and Lipids metabolism
- Amino acid and Nucleic acid metabolism.
- Bioenergetics.
- Photosynthesis
- Metabolic disorders.

UNIT I **9**

CARBOHYDRATES AND LIPID METABOLISM

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 **9**

AMINO ACID AND NUCLEIC ACID METABOLISM

Nitrogen fixation, Urea cycle, Synthesis and degradation of Arginine, Serine, Glycine, Aromatic aminoacids (Phenylalanine, Tyrosine, Tryptophan), Histidine, Glutamate. Transamination, Deamination, Decarboxylation. Important molecules derived from amino acids (Auxins, DOPA, Serotonin, Porphyrins, T3, T4, Adrenaline, Nonadrenaline, Histamine, GABA, Polyamines, etc.) Biosynthesis of nucleotides – *De novo* and salvage pathway, Degradation of nucleotides.

UNIT III **9**

BIOENERGETICS AND OXIDATIVE METABOLISM

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

UNIT IV **9**

PHOTOSYNTHESIS

Photosynthetic apparatus, Photosynthetic pigments, Mechanism of light reaction and dark reaction, C_3, C_4 and CAM pathways, Bacterial photosynthesis.

UNIT V **9**

CLINICAL BIOCHEMISTRY

Glycogen storage diseases, Diabetes mellitus, Niemann Pick disease, Gaucher's disease, Fabrys disease, Tay-sach's disease, Atheroscelerosis. Alkaptonuria, Albinism, Phenylketonuria, Parkinson's disease, Cystinuria, Alzheimer's disease, Xanthinuria, Orotic acidiuria, Gout, Leasch-Nyhan syndrome, Nucleoside Phosphorylase deficiency.

Total : 45 Hours

OUTCOMES

Upon completion of advanced biochemistry, students will be able

- To recognize how fundamental chemical principles and reactions are utilized in biochemical Processes.
- To apply knowledge gained in food and drug industries.
- To define various metabolic concepts for applying them to solve clinical problems.
- To summarize the knowledge of bimolecular to use them in biotechnology industry.

TEXT BOOKS

1. David L. Nelson and Michael M. Cox, 2005. Lehninger Principles of Biochemistry. *W. H. Freeman and Company, New York*, 4th Edn.
2. Jain, J. L., Sunjay Jain and Nitin Jain, 2005. Fundamentals of Biochemistry. *S. Chand & Company Ltd*., 6th Edn.

REFERENCES

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

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.

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, 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, Immunosuppression.

UNIT III **9**

TRANSPLANTATION AND AUTOIMMUNITY

HLA System, Transplantation – Organ transplantation, Grafting – graft rejection and prevention, 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 – Leprosy, Tuberculosis, Malaria, Filariasis, Amoebiasis, Rabies, Typhoid, Hepatitis, AIDS, Principles and strategy for developing vaccines, Newer methods of vaccine production.

UNIT V **10**

IMMUNOTECHNOLOGY

Antigen-antibody interaction, Agglutination and precipitation, Complement fixation test, Immunodiffusion, Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Western blotting, Immunoelectrophoresis, SDS – PAGE, Purification and synthesis of antigen, Fluorescence immunoassay – Immuno Fluorescence (IF), SLFIA DELFIA, Fluorescence Activated Cell Sorter, Immunomics.

Total : 45 Hours

OUTCOMES

- 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
- The students would be aware of how to produce the therapeutic/diagnostic molecules.
- The students would be aware of tumour, allergy and hypersensivity reactions.

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. 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.

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.

UNIT I **8**

BONDS AND ENERGIES IN PROTEIN MAKEUP

Covalent and Non-covalent interactions in protein structure, Chemical reactivity in relation to post translational modifications and peptide synthesis

UNIT II **10**

PROTEIN ARCHITECTURE

Primary structure, Secondary structures, Super secondary structures, Topology diagrams, Nucleotide binding folds, Prediction of substrate binding sites, 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, X-ray diffraction, Nuclear Magnetic Resonance and Infra Red Spectroscopy.

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, Membrane proteins, Bacteriorhodopsin and Photosynthetic reaction center, Enzymes: Serine proteases – understanding the catalytic design by engineering trypsin, chymotrypsin and elastase.

UNIT V **8**

PROTEIN ENGINEERING AND PROTEIN DESIGN

Site directed mutagenesis, Examples of engineered proteins – T4 Lysozyme and Recombinant Insulin, Protein design – Principles and examples.

Total : 45 Hours

OUTCOMES

After successful completion of the course students will have:

- Understanding of the necessary elements of protein overexpression systems in bacteria
- Capability to design all the steps required to produce an expression system for a new protein
- Capability to make and purify proteins
- Understanding of techniques for modifying proteins
- Experience with basic techniques for protein analysis

TEXT BOOKS

1. Branden, C. and Tooze, J., 1999. Introduction to Protein structure. 2nd *Garland Publishing,* NY, *USA*.
2. Thomas E. Creighton, 1993. Proteins. Structure and Molecular Properties. 2nd Edn., *W.H. Freeman.*

REFERENCES

1. Moody P.C.E. and Wilkinson A.J., 1990. Protein Engineering. *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 Engineering Handbook. Vol 1 & 2, 1st Edn., *Wiley Publishers.*
5. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemistry. 5th Edn., *W.H. Freeman and Company*.

YEAR	III		L	T	P	C
SEMESTER	V	BIOETHICS, BIOSAFETY AND IPR	3	0	0	3

AIM

To create awareness in Biosafety and ethical issues in Biotechnological process.

OBJECTIVES

At the end of the course the students will have a thorough knowledge on

- Bioethics and socioeconomic impacts.
- Human ethical issues.
- Ethical issues on GMOs.
- Biosafety guidelines and management.
- Patent system and IPR.

UNIT I **8**

BIOTECHNOLOGY AND BIOETHICS

Definition and concepts : Bioethics and nature, Bioethics and gender bias, Theology, Bioethics and National and International legislation / Law, rDNA guidelines, The ethical issues on legal and socioeconomic impacts of biotechnology.

UNIT II **9**

BIOETHICS AND HUMAN

Personhood, Bioethical issues in reproduction, Abortion, Population explosion and control, Assisted reproduction, AIDS, Egg donation, Prenatal screening and sex selection, Cloning, Ethical issues on life and death, Voluntary euthanasia and physician assisted suicide, Organ donation and transplantation.

UNIT III **9**

BIOETHICS AND NEW GENETICS

Ethical issues on Genetically engineered organisms and Genetically modified foods, Ethical issues on new genetics – Human genome project, Gene therapy, Stem cell research, National resource allocations.

UNIT IV **9**

INTRODUCTION TO BIOSAFTEY

Biosafety regulation and guidelines, Public acceptance issues for biotechnology – Case studies, Experimental protocol approvals, Levels of containment, Problems of biologically active biotechnology products, The Cartagena protocol on the biosafety and biosafety management.

UNIT V **10**

PROTECTION OF BIOTECHNOLOGICAL INVENTIONS

Objectives of patent system, Basic principles and general requirements of patent law, Biotechnological inventions and patent law, Legal development, Patentable subjects and protection in biotechnology, The patentability of microorganisms, Intellectual Property Rights (IPR) and World Trade Organization (WTO) regime, Consumer protection and IPR, IPR and Plant genetic resources, Plant Breeders Right, IPP, WIPO, GAAT, TRIPs.

Total : 45 Hours

OUTCOMES

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

- Define Biosafety and bioethics in the context of modern biotechnology.
- Demonstrate good laboratory procedures and practices.
- Describe the standard operating procedures for biotechnology research and assign Biosafety levels.
- Justify the design of confinement facilities at different Biosafety levels.
- Discuss the social and ethical issues related to plant and animal biotechnology.

TEXT BOOKS

1. Beler, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent Protection. *Oxford and IBH Publishing Co.*, New Delhi.
2. Singh, K. Intellectual Property Rights on Biotechnology. *BCIL*, New Delhi.
3. Smith, J.E., 2004. Biotechnology. 3rd Edn., *Cambridge University Press*.
4. Singh, B.D., 2002. Biotechnology. 2nd Edn., *Kalyani Publishers.*
5. Dubey, R.C., 2006. A Text Book of Biotechnology. *S. Chand and Co. Ltd.*

REFERENCES

1. Edmund G. Seebauer and Robert L Barry, 2001. Fundamentals of Ethics for Scientists and Engineers. *Oxford University Press*, Oxford.
2. Cartagena Protocol on Biosafety, January, 2000.
3. Traynor, P.L., 2000. Biosafety Management. *Virginia Polytechnic Institute Publication*.
4. Howell, Joseph, H. and William F. Sale, 1995. Life Choices : A Hasting Center Introduction to Bioethics. *Georgetown University Press*, Washington, D.C.
5. Veatch and Robert M., 2000. The Basics of Bioethics. *Prentice Hall*, Upper Saddle River, New Jersey.

YEAR	III	CHEMICAL AND BIOLOGICAL THERMODYNAMICS	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.

UNIT I **11**

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, Liquefaction.

UNIT II **13**

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 **12**

SOLUTION THERMODYNAMICS

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

UNIT IV **13**

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 **11**

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

OUTCOMES

At the end of this course, the student would have the ability

- To explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.
- To demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
- To design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
- To describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.

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 and Sons.*

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

AIM

To develop the skills of the students by providing hands on training in various Biochemical investigations.

OBJECTIVES

At the end of this laboratory course, the student would have learnt about the Qualitative analysis, Biochemical investigations, Thin Layer Chromatography.

EXPERIMENTS

1. Guidelines for using bio chemistry lab (Theory)
2. Concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, Precision, Sensitivity and Specificity (Theory)
4. Qualitative test for carbohydrates – Distinguishing reducing from non – reducing sugars and keto from aldo sugars.
5. Qualitative test for Amino acids.
6. Estimation of Glucose by O-toludine method
7. Quantitative method for Amino acid estimation using Ninhydrin – Distinguishing amino from imino acid.
8. Protein estimation by Biuret, Lowry's, Bradford methods.
9. Extraction of Lipids and analysis by TLC.
10. Estimation of Nucleic acids by absorbance at 260 nm and hyper chromic effect (Demo)
11. Estimation of Haemoglobin.
12. Enzymatic assay : Phosphatase from Potato.

OUTCOMES

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

- Classify the macromolecules and analyze their biological and chemical properties.
- Analyze and interpret the importance of carbohydrate, Lipid, amino acid and nucleotide metabolism in human body metabolism in human body.
- Formulate and evaluate the experimental methods used in biochemistry research laboratory

Use of the applicability of the biochemical methods to realistic situations

REFERENCES

1. Laboratory Manual.

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.

OUTCOMES

- 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.

EXPERIMENTS

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood groups.
4. Immunodiffusion and immunoelectrophoresis.
5. Testing for Typhoid antigens by Widal test.
6. Enzyme Linked Immuno Sorbent Assay (ELISA).
7. Isolation of pheripheral blood mononuclear cells.
8. Isolation of monocytes from blood.
9. Immunofluorescence.
10. Identification of T-cell rossetting using sheep RBC.

OUTCOMES:

- 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.

REFERENCES

1. Laboratory Manual.

VI SEMESTER

YEAR	III	GENETIC ENGINEERING	L	T	P	C
SEMESTER	VI		3	0	0	3

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.

UNIT I **9**

BASIC TOOLS IN GENETIC ENGINEERING

Core techniques in gene manipulations – Cutting and joining of DNA and vectors, DNA labelling – Radioactive and non-radioactive 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), Minisatellite sequences, Short Tandem Repeats (STR), Microsatellite sequences, Restriction mapping, Transcript mapping, Gene targetting, Transposon tagging.

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, Biodegradable plastics, Diagnostics, Pathogenesis, Genetic diversity, Therapeutic vaccines, Transgenic plants and animals, Safety lines for recombinant DNA techniques and guidelines for the disposal of Bio-waste.

Total : 45 Hours

OUTCOMES:

- 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.
- The students would be aware of microarrays, Analysis of Gene expression and proteomics.

TEXT BOOKS

1. Old, R.W. and Primrose, S.B., 1993. Principles of Gene Manipulation. An Introduction to Genetic Engineering. *Blackwell Scientific Publication*.
2. Freifelder, D., 1987. Molecular Biology. *Jones and Bartlett Publishers Inc.*
3. Brown, T.A. Gene Cloning.

REFERENCES

1. Sambrook and Elliot. Molecular Cloning. Vol. III.
2. Lewin, B.I. Genes VIII. *John Wiley & Sons, New York.*
3. Watson, J. Recombinant DNA Technology.
4. Winnacker. From Genes to Clones.
5. Ansubel, F.M., Brent, R., Kingston, R.E. and Moore, D.D., 1988. Current Protocols

in Molecular Biology. *Green Publishing Associates,* New York.

6. Glover, D. M., 1984. Gene cloning : The mechanism of DNA manipulation. *IRC Press*, Oxford University.
7. Jose Cibelli, Robert P. Lanza, Keith H.S. Campbell, Michael D. West, 2002. Principles of cloning. *Academic Press.*
8. Jeremn W. Dale and Malcolm Von Schantz, 2002. From genes to genomes. *John Wiley and Sons.*

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

AIM

To offer a focussed 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.
- Vectors and transgenic plants.
- Molecular markers and mapping.
- Gene cloning techniques and its importance.
- Transplantation and stem cell technology.

UNIT I **10**

PLANT CELL AND TISSUE CULTURE

Tissue culture media – Composition and preparation, Tissue culture as a technique to produce novel plants and hybrids, Organogenesis, Somatic embryogenesis, Shoot-tip culture, Embryo culture and embryo rescue, Protoplast isolation, Culture and fusion, Selection of somatic hybrids, Cybrids, Cryopreservation, DNA banking for germplasm conservation.

UNIT II **8**

PLANT VECTORS AND BIOLOGICAL NITROGEN FIXATION

Plant viruses – Classification, Types of plant vectors – Agrobacterium mediated gene transfer, Applications, Legume symbiosis, Nitrogen fixation, Regulation of nif and nod gene.

UNIT III **9**

MOLECULAR MARKERS AND MAPPING TECHNIQUES

Molecular markers - aided breeding, RFLP maps, STS, Micro satellites, SCAR (Sequence Characterized Amplified Regions), SSCP (Single Strand Conformational Polymorphism), AFLP, QTL map based cloning, Molecular markers assisted selection.

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 AND STEM CELL TECHNOLOGY

Gene transfer methods in animals, Xenotransplantation, Regulation of transgenic animals, Patenting genetically engineered animals, Stem cell technology.

Total : 45 Hours

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.

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.*
3. Dodds, J.H., 1985. Plant Genetic Engineering. *Cambridge University Press.*
4. Spier, R.E. and Griffiths, J.B., 1998. Animal Cell Biotechnology. *Academic Press.*
5. Masters, J.R.W., 2000. Animal Cell Culture. Practical Approach. *Oxford University.*
6. Heldt, H.W., 1997. Plant Biochemistry and Molecular Biology. *Oxford University*
7. Rainer Fischer, 2004. Molecular Farming. *John Wiley and Sons.*
8. Glyn Stacey, Nibsc, Ulk and John Davis, 2005. Medicines from Cell Culture. *John Wiley and Sons.*
9. Potten, C.S., 2006. Stem Cells. *Academic Press.*

YEAR	III		L	T	P	C
SEMESTER	VI	PRINCIPLES OF BIOINFORMATICS	3	0	0	3

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.

UNIT I **8**

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 **10**

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.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, students will be able to

- Develop bioinformatics tools with programming skills.
- Apply computational based solutions for biological perspectives.
- Pursue higher education in this field.
- Practice life-long learning of applied biological science

TEXT BOOKS

1. Rastogi, S.C., Namita Mendiratta, Parag Rastogi. Bioinformatics – Concepts, Skills, Application.
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. 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	III	BIOPROCESS ENGINEERING	L	T	P	C
SEMESTER	VI		3	0	0	3

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.

UNIT I **12**

INTRODUCTION TO BIOPROCESS AND FERMENTATION

Historical development of the fermentation industry, Outline of an integrated bioprocess and the various (Upstream, Downstream) unit operations involved in bioprocess, General requirements of fermentation process, Basic configuration of fermenter and ancillaries, Main parameters to be monitored and controlled in fermentation processes.

UNIT II **13**

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 : The logistic equation).

UNIT III **12**

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.

U**NIT IV** **11**

BIOREACTOR SCALE-UP AND MASS TRANSFER

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

UNIT V **12**

MONITORING OF BIOPROCESSES

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

Tutorial : 15
Total : 60 Hours

OUTCOMES:

Upon completion of Bioprocess Engineering course graduates will be able to

- 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.

TEXT BOOKS

1. Shuler and Kargi, 1992. Bioprocess Engineering. *Prentice Hall*.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamental. 2^{nd} 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.

UNIT I **11**

DIFFUSION

Molecular diffusion in fluids, Mass transfer coefficients, Diffusion in solids, Inter phase mass transfer.

UNIT II **13**

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 **13**

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.

UNIT IV **13**

LIQUID – LIQUID EXTRACTION

Liquid – Liquid Equilibria, Stage wise contact, Stage type extractor, Differential extractor

UNIT V **13**

SOLID – FLUID OPERATION

Adsorption equilibria – Liquids, Single gases and vapours, Leaching – Unsteady state

operation, Steady state continuous operation.

Tutorial : 15
Total : 60 Hours

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

TEXT BOOKS

1. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., *Mc Graw Hill*.
2. Geankoplis, C.J., 2002. Transport Processes and Unit Operations. 3rd Edn., *Prentice Hall of India*.

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. Mc Cabe, W.L., Smith, J.C., Harriot, P., 1993. Unit Operations in Chemical Engineering. 5th Edn., *McGraw Hill Book Co.*, New York.
4. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.
5. Butterworth - Heinemann, 1992. Bioprocess Technology : Modeling and Transport Phenomena.

YEAR	III	GENETIC ENGINEERING LAB	L	T	P	C
SEMESTER	VI		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 and nucleic acid separations.
- To amplify DNA using Polymerase Chain Reaction.
- To detect and characterize Nucleic acids, through the application of gene probes and blotting techniques.
- To acquire skills in Gene cloning and screening of recombinants.
- To analyze proteins through SDS-PAGE and Western blotting.

EXPERIMENTS:

1. Isolation of Genomic DNA from Plant / Animal / Bacterial Cells.
2. Isolation of Total RNA.
3. Isolation of Plasmid DNA.
4. Quantification of DNA and RNA.
5. Gel Electrophoresis of DNA – Agarose Gel, Polyacrylamide gel.
6. Southern Blotting.
7. Polymerase Chain Reaction.
8. Elution of Plasmid DNA from Agarose gel.
9. Restriction digestion of Bacterial Genomic and Plasmid DNA.
10. Ligation of DNA.
11. Preparation of Competent Cells.
12. Transformation in *E. Coli*.
13. Screening of Recombinants and Confirmation of Insert DNA in Plasmid.
14. SDS-PAGE.
15. Western Blotting.

OUTCOMES:

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

- Describe the main principles, methods for preparation and cloning of DNA in various organisms.
- 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 anddevelops new and improved living organisms.
- Students will be aware of the hazardous chemicals and safety precautions in case of emergency.

REFERENCES

1. Laboratory Manual.

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.

EXPERIMENTS

1. Growth of micro organism – Estimation of Monod parameters.
2. Medium optimization – Plackett Burman design.
3. Enzyme activity – Effect of temperature and pH.
4. Enzyme Immobilization – Gel Entrapment.
5. Enzyme Immobilisation – Cross linking.
6. a. Production of Secondary metabolite by Plant cells in a Photo bioreactor.
   b. Production of secondary metabolites in synthetic and complex industrial Media.
7. Production of Wine by Yeast.
8. Production of Amino acid.
9. Study of Rheology of Fermentation broth and Power determination.

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.

REFERENCES

1. Laboratory Manual.

VII SEMESTER

YEAR	IV		L	T	P	C
SEMESTER	VII	GENOMICS AND PROTEOMICS	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.

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.

U**NIT 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

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.

TEXT BOOKS

1. Rastogi, S.C., Mendiratta, N. and Rastogi, P. Bioinformatics Methods and Applications.
2. Andreas D. Baxevanis and Francis Oueliette, B.F. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins. *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	IV	BIOPHARMACEUTICAL TECHNOLOGY	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.

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

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

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.

UNIT I **10**

ROLE OF 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. Pre-treatment and stabilization of bioproducts.

UNIT II **8**

PHYSICAL METHODS OF SEPARATION

Unit operation for solid liquid separation – Removal of insolubles, Biomass (and particular debris), Flocculation and 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 different methods.

UNIT IV **10**

PRODUCT FRACTIONATION / PURIFICATION

Chromatography – Principles, Instrumentation, Adsorption, Reverse phase, Ion exchange, Hydrophobic interaction, Bioaffinity and pseudo affinity chromatographic techniques, Hybrid separation technology – Membrane chromatography, Electrochromatography, High

Performance Liquid Chromatography (HPLC).

UNIT V **8**

FINAL PRODUCT FORMULATION AND FINISHING OPERATION

Crystallization – Basic concepts, Crystal size distribution, Batch crystallisation, Recrystallisation, Drying – Drying equipment – Conduction dryers, Adiabatic dryers, Drying rate and drying time, Lyophilisation in final product formulation.

Tutorial : 15
Total : 60 Hours

O**UTCOMES:**

- 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

TEXT BOOKS

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

REFERENCES

1. Wankat, P.C., 1990. Rate Controlled Separation. *Elsevier*.
2. Better, P.A. and Cussler, E., 1985. Bioseparation. *Wiley*.
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	0	2	3

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 Characterisation of nanomaterials.
- Nanoparticles in biosystems.
- Role of microbes in Nanotechnology.
- Applications of Nanobiotechnology.

UNIT I **9**

INTRODUCTION

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

UNIT II **8**

FABRICATION AND CHARACTERISATION

Fabrication – Bottom-up Vs. Top-down, Epitaxial growth, Self assembly. Characterisation – X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Scanning Tunnelling 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 signalling and related proteins.

UNIT IV **9**

MICRO ORGANISMS AND NANOBIOTECHNOLOGY

Nanobiotechnology and micro organisms – Polyhydroxyalkanoates (PHA) – Cyanophycin inclusions – Magnetosomes – Alginates – Bacteriophages –

Bacterial spores – Bacterial protein complexes – 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, Tuberculosis and Leprosy), Commercializing Nanobiotechnology.

Tutorial : 15
Total : 60 Hours

OUTCOMES:

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

TEXT BOOKS

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

REFERENCES

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

YEAR	IV		L	T	P	C
SEMESTER	VII	CHEMICAL REACTION ENGINEERING	3	1	0	4

AIM

To make the students understand the underlying concepts of reaction kinetics, ideal and non-ideal reactors, a basis for Bioreactors

OBJECTIVES

To impart knowledge on

- Chemical Kinetics
- Ideal Reactors
- Single and Multiple Reactions
- Non-ideal Reactors
- Heterogeneous Reactions

UNIT I **9**

CHEMICAL KINETICS

Introduction to chemical kinetics, rate equation, concentration dependent term of a rate equation: single and multiple reaction. Elementary and non- elementary reactions. Molecularity and order, theories of reaction rate and temperature dependency.

UNIT II **9**

IDEAL REACTORS

Batch Reactor – Constant Volume, Variable volume batch reactor - Batch Reactor data for typical reactions – integral and differential method of analysis. Perfomance Equations for Single Batch reactor, Ideal CSTR, Ideal PFR

UNIT III **9**

SINGLE AND MULTIPLE REACTIONS

Design for single reaction: size comparison of single reactors, multiple reactor system, pfr in series/parallel, equal size mfr in series, Recycle reactor, introduction to multiple reactions, qualitative analysis of product distribution.

UNIT IV **9**

NON-IDEAL REACTORS

Residence time distribution as a factor performance, residence time function and relationship between them in reactor, basic models for non ideal reactor like dispersion model, tanks in series model.

UNIT V **9**

HETEROGENEOUS REACTIONS

Fluid particle reactions: selection of a model, unreacted core models for spherical particles, determination of the rate controlling step. Catalyst preparation, surface area and pore volume measurements: promoters, poisons.

Tutorial : 15
Total : 60 Hours

OUTCOMES:

Upon completion of this course, the student would be able

- To design and conduct an experimental investigation in order to determine rate equations.
- To demonstrate an ability to solve material and energy balances in order to analyze the performance of a reactor.
- To demonstrate an experimental data using standard statistical methods to establish quantitative results.
- To design a reactor for bio based products to achieve production and yield specifications.

TEXTBOOKS

1. Octave Levenspiel, Chemical Reaction Engineering, John Wiley and sons. 3rd Edition, 1999.
2. Gavhane K.A., Chemical Reaction Engineering – I, Nirali Prakashan Publishers, 2009.

REFERENCES

1. Foggler H.S., Elements of chemical reaction engineering, Prentice Hall Publishing Co. 4th Edition, 2006.
2. Smith J.M., Chemical Engineering Kinetics, McGraw-Hill Inc 2003.
3. Narayanan, K.V., 2001. A Text Book of Chemical Engineering Thermodynamics. *Prentice Hall India.*
4. Smith, J.M., Van Ness, H.C. and Abbot, M.M., 2001. Chemical Engineering Thermodynamics. 6th Edn., *McGraw- Hill.*
5. Irving J. Dunn and Eth Zurich, 2003. Biological Reaction Engineering. *John Wiley and Sons.*

YEAR	IV		L	T	P	C
SEMESTER	VII	TOTAL QUALITY MANAGEMENT	3	0	0	3

AIM

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

OBJECTIVES

To familiarize about

- Quality concepts.
- TQM principles.
- Statistical process control.
- TQM tools.
- Quality systems.

UNIT I **10**

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 **10**

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 – Basic concepts – Strategy – Performance measures.

UNIT III **8**

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 **8**

QUALITY SYSTEMS

Need for ISO 9000 and other quality systems – ISO 9000 : 2000 Quality system – Elements – Implementation of quality system – Documentation – Quality auditing – QS 9000 – ISO 14000 – Concept – Requirements and benefits.

Total : 45 Hours

OUTCOME*:*

After Completion of the course, the learner may understand the overall TQM practices for improve all performance measures and to fulfill the customer expectation.

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*.

YEAR	IV	DOWNSTREAM PROCESSING 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.

EXPERIMENTS

1. Solid-Liquid Separation – Centrifugation, Micro filtration.
2. Cell Disruption Techniques – Ultra sonication, French Pressure Cell.
3. Cell Disruption Techniques – Dyno Mill – Batch and Continuous.
4. Precipitation – Ammonium Sulphite Precipitation.
5. Ultra Filtration Separation.
6. Aqueous Two Phase Extraction of Biologicals.
7. High Resolution Purification – Affinity Chromatography.
8. High Resolution Purification – Ion Exchange Chromatography.
9. Product Polishing – Gel Filtration Chromatography.
10. Product Polishing – Spray Drying, Freeze Drying.

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.

REFERENCES

1. Laboratory Manual.

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

OBJECTIVE

- The objective of the project work is to enable the students to form the groups of not more than 3 members on a project involving theoretical and experimental studies related to the branch of study.

- Formation of Group as follows
  - Group A : 8.5CGPA and above
  - Group B : 7 to 8.49 CGPA
  - Group C : 5 to 6.9 CGPA

  Group A Student will have a choice to take 2 students from Group B&C

- Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

- The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

- The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

- Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

- This final report shall be typewritten form as specified in the guidelines.

- The continuous assessment shall be made as prescribed in the regulations

- Every Student is expected to publish their research findings in a Journal/Conference proceedings. The Evidence of sending/publishing to be produced at the time of submitting their project report

ELECTIVES

		L	T	P	C
ELECTIVE	**IMMUNOTECHNOLOGY**	**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.

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

OUTCOMES

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

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.*

REFERENCE

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*.

		L	T	P	C
ELECTIVE	**CANCER BIOLOGY**	**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.

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

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

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.*

		L	T	P	C
ELECTIVE	**MOLECULAR PATHOGENESIS**	**3**	**0**	**0**	**3**

AIM

To widen the students knowledge in the area of Molecular pathogenesis.

OBJECTIVES

To make the students understand about the concepts of

- Pathogenicity.
- Host-defense against Pathogens and pathogenic strategies.
- Molecular pathogenesis.
- Experimental studies on Host-Pathogen interaction.
- Modern approaches to control Pathogens.

UNIT I **9**

INTRODUCTION

Introduction to pathogenesis, Attributes of microbial pathogenicity, Components of microbial pathogenicity, Population genetics of Microbial Pathogenicity, Methods to detect genetic diversity and Structure in nature population, Epidemiology, Cryptic diseases.

UNIT II **9**

HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES

Attributes and components of microbial pathogenesis, Host Defense : Skin, Mucosa, Cilia, Secretions, Physical movements, Limitation of free iron, Antimicrobial compounds, Mechanism of killing by humoral and cellular defense mechanisms, Complements, Inflammation process, General disease symptoms, Pathogenic adaptations to overcome the above defenses.

UNIT III **10**

MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES)

Virulence, Virulence factors, Virulence-associated factors and virulence lifestyle factors, Molecular genetics and gene regulation in virulence of pathogens, *Vibrio Cholerae* : Cholera toxin, Co-regulated pili, Survival *E. coli* pathogens : Enterotoxigenic *E. coli* (ETEC), Labile and stable toxins, Entero-pathogenic *E. coli* (EPEC), Type III secretion, Cytoskeletal changes, Intimate attachment; Enterohaemerrohogic *E. coli* (EHEC), Mechanism of bloody diarrohea and Hemolytic Uremic Syndrome, Enteroaggregative *E.*

coli (EAEC). Plasmodium : Life cycle, Erythrocyte stages, Transport mechanism and processes to support the rapidly growing schizont, Parasitiparous vacuoles and knob protein transport, Antimalarials based on transport processes. Influenza virus : Intracellular stages, Neuraminidase and Haemagglutinin in entry, M1 and M2 proteins in assembly and disassembly, Action of amantidine.

UNIT IV **8**

EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS

Virulence assays : Adherence, Invasion, Cytopathic, Cytotoxic effects, Criteria and tests in identifying virulence factors, Attenuated mutants, Molecular characterization of virulence factors, Signal transduction and host responses.

UNIT V **9**

MODERN APPROACHES TO CONTROL PATHOGENS

Classical approaches based on serotyping, Modern diagnosis based on highly conserved virulence factors, Immuno and DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines – DNA, Subunit and cocktail vaccines.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, the student will be able to understand the

- Host pathogen interactions at the level of cellular and molecular networks.
- Diagnosis of diseases through the examination of molecules.
- Modern therapeutic strategies on various pathogens.

TEXT BOOKS

1. Iglewski, B.H. and Clark, V.L., 1990. Molecular Basis of Bacterial Pathogenesis. *Academic Press.*
2. Peter Williams, Julian Ketley and George Salmond, 1998. Methods in Microbiology : Bacterial Pathogenesis. Vol. 27. *Academic Press.*

REFERENCES

1. Recent Reviews in *Infect. Immu., Mol. Microbiology, Biochem. J., EMBO* etc.
2. Nester, Anderson, Roberts, Pearsall and Nester, 2001. Microbiology : A Human Perspective. 3rd Edn., *Mc Graw-Hill*.
3. Eduardo, A., and Groisman, 2001. Principles of Bacterial Pathogenesis. *Academic Press*.
4. Digard, P., Nash, A. A. and Randall, R. E., 2005. Molecular Pathogenesis of Virus

Infection. *Cambridge University Press.*

5. Brenda A. Wilson and Abigail A. Salyers, 2011. Bacterial Pathogenesis : A Molecular Approach. *American Society for Microbiology*.

		L	T	P	C
ELECTIVE	**METABOLIC ENGINEERING**	**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.

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

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

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.*

		L	T	P	C
ELECTIVE	**CONCEPTS IN BIOTECHNOLOGY**	**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 through 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.

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 Flavr Savr Tomato, 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 pur ification, 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, Bioremediation and its applications. 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

OUTCOMES:

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

- To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.
- To apply basic biotechnological principles, methods and models to solve biotechnological tasks.
- To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.
- To design and deliver useful modern biotechnology products to the Society.

TEXT BOOKS

1. Gupta, P.K. 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. 2ndEdn., *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.

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

AIM

To know the fundamentals of Neuroscience by studying the Neuroanatomy, Physiology, Pathology, Pharmacology of the Nervous system.

OBJECTIVES

To impart Knowledge on

- Neuroanatomy - Central and peripheral nervous system.
- Neurophysiology – Action Potenials and Coding by neurons.
- Neuropharmocology – Neurotransmitters.
- Pathology of the Nervous system – Disorders
- Neurotechniques – To understand the chemistry and functions of Nervous system.

UNIT I **9**

NEUROANATOMY

What are central and peripheral nervous systems; Structure and function of neurons; types of neurons; Synapses; Glial cells; myelination; Blood Brain barrier; Neuronal differentiation; Characterization of neuronal cells; Meninges and Cerebrospinal fluid; Spinal Cord.

UNIT II **9**

NEUROPHYSIOLOGY

Resting and action potentials; Mechanism of action potential conduction; Voltage dependent channels; nodes of Ranvier; Chemical and electrical synaptic transmission; information representation and coding by neurons.

UNIT III **9**

NEUROPHARMACOLOGY

Synaptic transmission, neurotransmitters and their release; fast and slow neurotransmission; characteristics of neurites; hormones and their effect on neuronal function.

UNIT IV **9**

PATHOLOGY OF THE NERVOUS SYSTEM

Molecular and cellular mechanisms – pathological features of genetics of multiplesclerosis – Parkinson’s Diseases – Huntington’s Diseases – Alzheimer’s Diseases.

UNIT V **9**

NEUROSCIENCE METHODS AND TECHNIQUES

Techniques to understand the functions of nervous system: Patch clamp techniques, intracellular recording, extra cellular recording, mass unit recording, Evoked potentials and electro encephalographic(EEG).

Techniques to understand the chemistry of nervous system: Brain imaging, CT scan, PET, MRI, FMRI, Angiography.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, students will be able:

- To know the anatomy and organization of nervous systems.
- To understand the function of nervous systems.
- To analyze how drugs affect cellular function in the nervous system.
- To understand the basic mechanisms associated with behavioral science.

TEXTBOOKS

1. Mathews G.G. Neurobiology, 2nd Edn., Blackwell Science, UK, 2000.
2. Eric. R. Kandel, James H.S. Chwarts and Thomas M. Jessel, Principles of Neural Science, 4th Edition, 2006

REFERENCES

1. Gupta, Basic Neuro Anantomy, McGraw Hill, 5th Edn., 2006.
2. David Robinson, 1998. Neurobiology. *Springer.*
3. Peggy Mason, 2011. Medical Neurobiology. *Oxford University Press.*
4. Dale Purves, 2012. Neuroscience. 5th Edn., Science, *Sinauer Associates Inc*.
5. Gary G. Mathews, 2001. Neurobiology : Molecules, Cells and Systems. *Wiley & Sons*.

		L	T	P	C
ELECTIVE	**BIOCONJUGATE TECHNOLOGY**	**3**	**0**	**0**	**3**

AIM

To develop the skills of student in the area of Bioconjucate technology.

OBJECTIVES

At the end of the course, the student would have learnt about.

- Modification of amino acids, sugars and nucleic acids.
- Chemistry of active groups.
- Chemical tags and probes in Bioconjucate technology.
- Enzyme and DNA labelling.
- Applications.

UNIT I **8**

FUNCTIONAL TARGETS

Modification of Amino acids, Peptides and Protein – Modification of sugars, Polysaccharides and glycoconjugates – Modification of nucleic acids and oligonucleotides.

UNIT II **9**

CHEMISTRY OF ACTIVE GROUPS

Amine reactive chemical reactions – Thiol reactive chemical reactions – Carboxylate reactive chemical reactions – Hydroxyl reactive chemical reactions – Aldehyde and ketone reactive chemical reactions – Photoreactive chemical reactions.

UNIT III **9**

BIOCONJUGATE REAGENTS

Zero length cross linkers – Homobifunctional cross linkers – Heterobifuntional crosslinkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV **9**

ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUCATION

Properties of common enzyme – Activated enzymes for conjugation – biotinylated enzymes – chemical modification of nucleic acids – biotin labeling of DNA – enzyme conjugation to DNA – Fluorescent of DNA.

UNIT V **10**

BIOCONJUGATE APPLICATIONS

Preparation of Hapten – carrier immunogen conjugates – antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives – Colloidal – gold – labelled proteins – modification with synthetic polymers.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, the student would know about

- Joining of two molecules to form a hybrid conjugate with the help of linkers.
- Active groups of various chemical reactions and targets of the functional groups.
- Antibody modification and conjugation.

TEXT BOOK

1. Hermanson, G.T., 1999. Bioconjugate Techniques, *Academic Press.*
2. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 2002. Biochemistry. 5th Edn., *W. H. Freeman and Company*

REFERENCES

1. Claude F. Meares, 1993. Perspectives in Bioconjugate Chemistry. *ACS Publication*.
2. Pandalai, S. G., 2005. Recent Research Developments in Bioconjugate Chemistry. Vo. II, *Transworld Research Network.*
3. Aimee Renae Herdt, 2007. Engineering Biomolecules and Nanostructures for Bioconjugate Chemistry. *University of Minnesta.*
4. Zubay, G., 1987. Biochemistry. 2nd Edn., *Maxwell Macmillan International Editions.*
5. Dugas, H., 1989. Bio-organic Chemistry – A Chemical Approach to Enzyme Action. *Springer Verlag.*

		L	T	P	C
ELECTIVE	**CRYOPRESERVATION THEORY AND APPLICATIONS**	**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.

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

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.

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*.

		L	T	P	C
ELECTIVE	**STEM CELL BIOLOGY**	**3**	**0**	**0**	**3**

AIM

To understand the fundamental concept of Stem cell technology.

OBJECTIVES

At the end of the course the student would have gained extensive knowledge on

- Types of Stem cell and its characterization.
- Cell lines and Tissue engineering.
- Isolation and Cloning of stem cells.
- Types of Stem cell transplantation.
- Applications and Ethics.

UNIT I **8**

INTRODUCTION

Stem cell – Definition, Embryonic stem cells, Adult stem cells, Origin and characterization of human stem cells and potential applications for stem cell research, Cord blood stem cells, Stem cell marker

UNIT II **10**

CELL LINES AND TISSUE ENGINEERING

Cell types and sources, Human tissue culture media, Culturing of cell lines, Biology and characterization of cultured cells, Maintenance and management of cell lines, 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, Liver tissue engineering.

UNIT III **9**

ISOLATION AND CLONING OF STEM CELLS

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 **9**

TRANSPLANTATION AND TRANSFECTION

Types of stem cell transplantation – Autologous, Allogeneic, Syngeneic; Nuclear transplantation, Therapeutic transplantation, Transfection methods – Lipo fection, Electroporation, Microinjection, Embryonic stem cell transfer and Targetted gene transfer.

UNIT V **9**

APPLICATIONS AND ETHICS

Neural stem cells for Brain / Spinal cord repair, Miracle stem cell heart repair, Stem cell and future of regenerative medicine, 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 stem cell research in India, Human embryonic stem cell ethics and Public policy.

Total : 45 Hours

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

Overall exposure to the role of tissue engineering and stem cell therapy in organogenesis

TEXT BOOKS

1. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey and Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering. *CRC Press*.
2. John, R. and Master, W., 2004. A Practical Approach. *Oxford University Press.*

REFERENCES

1. Stewart Sell. Stem Cell Handbook. *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. Embryonic Stem Cells: Developmental Capabilities and their Possible Use in Mammalian Embryo Cloning. *Animal Reproduction Science* 42 : 437 – 446.

		L	T	P	C
ELECTIVE	**CLINICAL TRIALS**	**3**	**0**	**0**	**3**

AIM

To understand the basic concepts in Clinical trial and its importance and applications.

OBJECTIVES

- Purpose of Clinical research.
- Terminology used in Clinical research.
- Clinical trials – Phase – I, II, III, and IV.
- Preclinical toxicology study.
- Applications.

UNIT I **9**

PURPOSE OF RESEARCH

Research – Meaning, Purpose, Types, (Educational, Clinical, Experimental, Historical Descriptive, Basic applied and Patent oriented research), Objectives of research, Literature survey – Use of Library, Books and Journals – Medlines – Internet, Patent Search and Reprints of articles as a source for Literature survey, Selecting a problem and preparing research proposals.

UNIT II **9**

BASIC TERMINOLOGY USED IN CLINICAL RESEARCH

Types of clinical trials, Single blinding, Double blinding, Open access, Randomized trials and their examples, Interventional study, Ethics committee and its members, Cross over design, etc. and Institution Ethics Committee / Independent Ethics Committee, Data management in clinical research.

UNIT III **10**

C**LINICAL TRIALS**

New drug discovery process – Purpose, Main steps involved in new drug discovery process, Timelines of each steps, Advantages and purposes of each steps, Ethics in clinical research, Unethical trials, Thalidomide tragedy, Phase – I, II, III, IV trials (Introduction and designing, Various phases of clinical trials, Post marketing surveillance, Methods, Principles of sampling, Inclusion and exclusion criteria, Methods

of allocation and randomization, Informed consent process in brief, Monitoring treatment outcome, Termination of trial, Safety monitoring in clinical trials).

UNIT IV **8**

PRECLINICAL TOXICOLOGY

General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, Animal toxicity requirements.

UNIT V **9**

APPLICATIONS

Study of various clinical trials (completed or ongoing), Clinical trial applications in India Import and export of drug in India, Investigational New Drug application (IND), Abbreviated New Drug Application (ANDA), New Drug Application (NDA).

Total : 45 Hours

OUTCOMES

The course will give the students,

- Knowledge of guidelines and other relevant documents associated with execution of clinical trials.
- An overview of the different trial phases, research methology, ethical considerations, quality assurance, evaluation of results and statistical methods used in clinical trials.

TEXT BOOKS

1. Katzung, B. G. Basic and Clinical Pharmacology. *Prentice Hall International*.
2. Laurence, D. R. and Bennet, P. N. Clinical Pharmacology. *Scientific Book Agency*.
3. Krishna, D. R. and Klotz, V. Clinical Pharmacokinetics. *Springer Verlab*.
4. Lippincott, Williams and Wilkins. Remington Pharmaceutical Sciences.
5. Kven Stockley and Hamsten. Drug interaction.

REFERENCES

1. Ethical Guidelines for Biomedical Research on Human Subjects. *Indian Council of Medical Research*, New Delhi, 2000.
2. Rick, N.G., 2004. Drug from Discovery to Approval. *John Wiley & Sons Inc.*.
3. Mehra, J. K. Drug interaction. *Basic Bussiness Publication.*
4. Grahame smith and Aronson. Clinical Pharmacology and Drug Therapy.
5. Richard A. Helms. Text Book of Therapeutics Drug and Disease Management. Hardbound.
6. Herfindal, E. T., Hirschman, J. L., Williams and Wilkins. Clinical Pharmacy and Therapeutics.

		L	T	P	C
ELECTIVE	**MATERIAL SCIENCES AND TECHNOLOGY**	**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.

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

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
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning

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.*

2. 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*.

		L	T	P	C
ELECTIVE	**BIOLOGICAL SPECTROSCOPY**	**3**	**0**	**0**	**3**

AIM

The course enables the student to understand the principles of various spectroscopic techniques and its significance to biological systems and processes.

OBJECTIVES

To emphasize on the principles, operations and applications of

- General spectroscopic techniques.
- Infrared Spectroscopy.
- Ultraviolet – Visible Spectroscopy.
- Nuclear Magnetic Resonance Spectroscopy.
- Electron Para Magnetic Resonance Spectroscopy.

UNIT I **9**

SPECTROSCOPY AND OPTICAL ROTATORY DISPERSION

Interaction of radiation with matter, definitions frequency, wavelength, wave number, type of electromagnetic radiation, inter particle forces and energies, energy levels, population of energy levels, scattering, absorption and emission, Polarized light, Optical rotation, Circular dichroism – Circular dichroism of nucleic acids and proteins.

UNIT II **9**

ULTRA – VIOLET AND VISIBLE ABSORPTION SPECTROSCOPY

Electronic energy levels – electronic transitions, Selection regales, Absorption range of biological chromophores, Transition metal d-d transitions – Charge transfer spectra, Application of UV spectra to proteins, Properties associated with the transition dipole moment and interactions between them, Measurement of molecular dynamics by fluorescence spectroscopy.

UNIT III **8**

MASS SPECTROSCOPY

Ion sources sample introduction – Mass analyzers and ion detectors, Biomolecule mass spectrometry – Peptide and protein analysis – Carbohydrates and small molecules, Specific applications.

UNIT IV **10**

NUCLEAR MAGNETIC RESONANCE

The phenomenon – Magnetization – Measurement, Spectral parameters in NMR, Intensity, Chemical shift-spin, Spin coupling, T1 and T2 relaxation times, Line widths, Nuclear overhauser effect, Chemical exchange, Paramagnetic centers, Applications of NMR in biology, Assignment in NMR, Studies of macromolecules, Ligand binding, Ionization studies and pH kinetics, Molecular motion.

UNIT V **9**

ELECTRON PARAMAGNETIC RESONANCE

Introduction – Resonance condition – Measurement – Spectral parameters, Intensity g values – Spectral anisotropy, Time scale of EPR – Spin labels transition metal ions, Spin trapping.

Total : 45 Hours

OUTCOMES

Upon completion of this course, the student would be able understand

- Basics of optical rotary dispersion methods and nuclear magnetic resonance
- Principles and applications of mass spectrometry and X-ray diffraction
- About the microscopic techniques and applications
- And apply the spectroscopic techniques for various biological applications

TEXT BOOKS

1. Chatwal and Anand. Instrumental Methods of Analysis.
2. Skoog, D., 2000. Instrumental Methods of Analysis.

REFERENCES

1. Campbell, I.D. and Dwek, R.A., 1986. Biological Spectroscopy, *Benjamin Cummins and Company*.
2. Atkins, P.W., 1990. Physical Chemistry, 4^{th} Edn., *Oxford.*
3. Willard, H.H., Merrit, J.A., Dean, L.L. and Setlle, F.A., 1986. Instrumental Methods of Analysis. *CBS Publishers and Distributors.*
4. Gordon G. Hammes., 2005. Spectroscopy for Biological Science. *Wiley & Sons Publications.*
5. Iain D. Campbell., Raymond A. Dwek., 1984. Biological Spectroscopy. *Benjamin Cummins and Company*.

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

AIM

To develop the skills of the students in the area of Biophysics

OBJECTIVES

To study in detail about

- Molecular structure of biological system.
- Conformation of proteins
- Conformation of nucleic acids.
- Transport across ion channels.
- Energetics of biological system.

UNIT I **9**

MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS

Intra molecular bonds – covalent – ionic and hydrogen bonds – biological structures – general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

UNIT II **9**

CONFORMATION OF NUCLEIC ACIDS

Primary structure – the bases – sugars and the phosphodiester bonds – double helical structure – the a, b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids.

UNIT III **9**

CONFORMATION OF PROTEIN

Conformation of the peptide bond – Secondary structures – Ramachandran plots – use of potential functions – Tertiary structure – foldings – hydration of proteins – hydropathy index.

UNIT IV **9**

CELLULAR PERMEABILITY AND ION TRANSPORT

Ionic conductivity – transport across ion channels – mechanism – ion pumps – proton transfer – nerve conduction – techniques of studying ion transport and models.

UNIT V **9**

ENERGETICS AND DYNAMICS OF BIOLOGICAL SYSTEMS

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, students will be able:

- To analyze the various forces responsible for biological molecular structure.
- To be familiar with different levels of conformation in biomolecules.
- To gain the knowledge of cellular permeability and ion transport.
- To understand the dynamics of biological systems

TEXT BOOKS

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

REFERENCES

1. Vasantha Pattabhi and Gautham, N., 2009. Biophysics. *Morgan & Claypool*.
2. Patrick F. Dillon, 2012. Biophysics – A Physiological Approach. *Cambridge University Press*, New York.
3. Rodney Cotterill, 2002. Biophysics – An Introduction. *John Wiley & Sons*.
4. Gregory Dewey, 1998. Fractals in Molecular Biophysics. *Cambridge University Press, USA.*
5. Cantor, C. R. And Schimmel, P. R., 1980. Biophysical Chemistry. Vo. 1 – 3, *W. H. Freeman & Co*.

		L	T	P	C
ELECTIVE	**MOLECULAR MODELLING AND DRUG DESIGN**	**3**	**0**	**0**	**3**

AIM

The subject puts emphasis on the principles of Modelling and the studies of simulation of drug design and delivery.

OBJECTIVES

To familiarize and expose and to develop the skill of the students on the concept of

- Fundamental binding forces in molecules and molecular mechanism.
- Computer simulation methods.
- Molecular dynamic simulation method.
- Metropolis method.
- Significance of molecular Modelling in drug discovery and design.

UNIT I **9**

EMPIRICAL FORCE FIELDS MOLECULAR MECHANISMS

Bond stretching, Angle bending, Torsional terms, Improper torsions and Out of plane bonding motions, Electrostatic interactions, Van Der Waals interactions, Effective pair potentials, Hydrogen bonding, Force field models for Simulation of liquid water.

UNIT II **9**

COMPUTER SIMULATION METHODS

Calculation of thermodynamic properties, phase space, practical aspects of computer simulation, Boundaries, monitoring the equilibration, truncating potential and minimum image convention, Long range forces, Analysing results of simulation and estimating errors.

UNIT III **9**

MOLECULAR DYNAMICS SIMULATION METHODS

Molecular dynamics using simple models, Molecular dynamics with continuous potentials, Setting up and Running Molecular Dynamics simulation, Constraint dynamics, Time dependent properties, Molecular Dynamics at constant Temperature and pressure.

UNIT IV **9**

MONTE CARLO SIMULATION METHODS

Metropolis methods, Monte Carlo simulation of molecules, Monte Carlo simulation of polymers, Baised Monte Carlo Methods, Calculating chemical potentials. Monte Carlo or Molecular dynamics.

UNIT V **9**

MOLECULAR MODELLING TO DISCOVER AND DESING NEW MOLECULES

Molecular Modelling in drug discovery, Deriving and using 3D Pharmacophores, Molecular docking, Molecular Similarity and Similarity Searching, *de novo* ligand design.

Total : 45 Hours

OUTCOMES

- The students should be acquainted with theoretical and practical knowledge of molecular modeling tools and techniques for drug design and discovery.
- The knowledge of molecular modeling software will be useful for for commercial projects related to drug discovery and developments.
- The detailed knowledge and skill is given in the course and the students get acquired the same after studying the course

TEXT BOOKS

1. Leach, A. R., 1996. Molecular Modelling Principles and Applications. *Longman*.
2. Haile, J. M., 1997. Molecular Dynamics Simulation Elementary Methods. *John Wiley and Sons.*

REFERENCES

1. Vinter, J. G. and Mark Gardner, 1994. Molecular Modelling and Drug Design, *CRC Press IN.C*
2. Claude N. Cohen, 1996. Guidebook on Molecular Modelling in Drug Design. *Gulf Professional Publishing.*
3. Tamar Schlick, 2010. Molecular Modelling and Simulation : An Interdisciplinary Guide. *Springe.r*
4. Leach, 2009. Molecular Modelling : Principles and Applications. *Pearson Education India*, 2nd Edn.
5. Elaine A. Moore, 2002. Molecular Modelling and Bonding. *Royal Society of Chemistry.*

		L	T	P	C
ELECTIVE	**BIOSENSOR PRINCIPLES AND APPLICATIONS**	**3**	**0**	**0**	**3**

AIM

To understand the various types of Biosensors and to get familiarised with the principles of Biosensors.

OBJECTIVES

To acquire indepth knowledge in topics like

- Principles and types of biosensors
- Components of Biosensors and biochemical recognition
- Assaying labels and formats for biosensors
- Applications of Biosensors in medicine and health care
- Biosensors for environmental monitoring and industrial process

UNIT I **8**

PRINCIPLES AND TYPES OF BIOSENSORS

Overview of Biosensor principles, Types of biosensors – Electrochemical, Amperometric, Thermistor, Bioaffinity, Whole cell and opto-electronic biosensor.

UNIT II **10**

COMPONENTS OF BIOSENSORS AND BIOCHEMICAL RECOGNITION

Biological components – Enzymes : Biological catalysts, Specificity, Activity, Storage / shelf life. Enzyme kinetics in solution and on a surface. Cells : Signal transduction through chemoreception, Membrane potential, Cell metabolism, Antibodies : Immunochemistry, Binding affinity and kinetics; Hapten synthesis. Nucleic Acids (RNA and DNA) : Basic biochemistry, Hybridization; Amplification / Self replication; Secondary structure and folding, Physical components – Electrode, Photo cell and thermistor.

UNIT III **9**

ASSAYING LABELS AND FORMATS FOR BIOSENSORS

Labels : Radioisotopes, Fluorophores, Dyes, Enzymes / Substrates, Liposomes, Electroactive compounds, ELISAs and nucleotide capture assays, Immobilization of biorecognition element; Conjugation of labels.

UNIT IV **9**

APPLICATIONS OF BIOSENSORS IN MEDICINE AND HEALTH CARE

Biosensors for diabetics management, Detection of cancer and infectious diseases, Urease, ChOx and tyrosinase, Biosensors and their application in monitoring clinical metabolites, Biochips.

UNIT V **9**

BIOSENSORS FOR ENVIRONMENTAL MONITORING AND INDUSTRIAL PROCESS

Detection of pesticides and phenolic compounds, Commercial applications of biosensors in Food, Pharmaceutical and Cosmetic industries.

Total : 45 Hours

OUTCOMES

The student will be able to :

- describe the most common sensor principles used today, such as electric, optical, and mechanic registration.
- describe how biospecific interaction used for various applications
- compare different techniques with emphasis on sensitivity and selectivity

describe and critically evaluate a selected application of a biosensor

TEXT BOOKS

1. Spichiger-Keller, U. E., 1998. Chemical Sensors and Biosensors for Medical and Biological Applications. *Wiley-VCH*.
2. Dubey, R.C., 2006. A Text Book of Biotechnology. *S. Chand and Co. Ltd.*

REFERENCES

1. Mathews, C. K., Evan Holde, K. and Ahern, K. G., 2000. Biochemistry. *Addison Wesley Longman, Inc.*, 3rd Edn..
2. Horowitz, P. and Hill, W., 1989. The Art of Electronics. *Cambridge University Press*, 2nd Edn.
3. Florinee – Gabriel Banica, 2012. Chemical Sensors and Biosensors : Fundamentals and Applications. 1st Edn., Wiley Publications.
4. Robert S. Marks, David C. Cullen and Isao Karube, 2007. Handbok of Biosensors and Biochips. Howard H. Weerall and Christopher Robin Lene (ED.), *Wiley – Blackwell Publisher*.
5. Jan Cooper, Cass, A. E. G., 2004. Biosensors, *Oxford University Press.*

		L	T	P	C
ELECTIVE	**BIOPROCESS ECONOMICS AND PLANT 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.

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 AND QUALITY CONTROL

Current good manufacturing practices. Concepts of quality control in 20th 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

OUTCOMES:

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.

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. 9th 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. 2nd Edn., *Mc Graw Hill.*

	PROCESS INSTRUMENTATION DYNAMICS AND	**L**	**T**	**P**	**C**
ELECTIVE	**CONTROL**	**3**	**0**	**0**	**3**

AIM:

To understand the basic concepts involved in control system strategies of different process and their instrumentation dynamics.

OBJECTIVES

To study in detail about

- The dynamics behavior of chemical processes
- Design of feedback control systems
- Frequency response analysis
- Advanced control systems
- Multiparameter control

UNIT I **9**

ANALYSIS OF THE DYNAMIC BEHAVIOUR OF CHEMICAL PROCESSES

Laplace transformation, Transform of standard functions, Derivatives and integrals, Inversion, Theorems in Laplace transformation, Application. Open-loop systems, First order systems and their transient response for standard input functions, First order systems in series, Linearization and its application in process control, Second order systems and their dynamics, Transfer function for chemical reactors and dynamics.

UNIT II **9**

DESIGN OF FEEDBACK CONTROL SYSTEMS

Closed loop control systems, Development of block diagram for feed-back control systems, Servo and regulator problems, Transfer function for controllers and final control element, Principles of pneumatic and electronic controllers, Transportation lag, Transient response of closed-loop control systems and their stability.

UNIT III **8**

FREQUENCY RESPONSE ANALYSIS

Introduction to frequency response of closed-loop systems, Control system design by frequency, Bode diagram, Stability criterion, Nyquist diagram; Tuning of controller settings.

UNIT IV **9**

ADVANCED CONTROL SYSTEMS

Controller mechanism, Introduction to advanced control systems, Cascade control, Feed Forward control, Control of distillation towers and heat exchangers, Introduction to microprocessors and

computer control of chemical processes.

UNIT V **10**

MULTIPARAMETER CONTROL

Principles of measurements and classification of process control instruments, Measurements of Temperature, Pressure, Fluid flow, Liquid weight and Weight flow rate, Viscosity and Consistency, pH, Concentration, Electrical and Thermal conductivity, Humidity of gases, Composition by physical and chemical properties and spectroscopy.

Total : 45 Hours

OUTCOMES:

- Knowledge of field instrumentations
- Dynamic modeling and system behavior study
- Design of controllers
- Application of control systems in processes

TEXT BOOKS

1. Coughnowr and Koppel, 1986. Process Systems Analysis and Control. *McGraw-Hill*.
2. Stephanopolous and George, 1990. Chemical Process Control. *Prentice-Hall of India*.

REFERENCES

1. Emenule and Savas, S., 1965. Computer Control of Industrial Processes. *McGraw- Hill.*
2. Eckman, D.P., 1978. Industrial Instrumentation. *Wiley & Sons*.
3. Harriot, P., 1984. Process Control. *McGraw-Hill.*
4. Smith, C. A. and Corripio, A. B., 1997. Principles and Practice of Automatic Process Control. 2nd Edn., *John Wiley & Sons*.
5. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamentals. 2nd Edn., *Mc Graw Hill*.

		L	T	P	C
ELECTIVE	**PROCESS MODELLING AND SIMULATION**	**3**	**0**	**0**	**3**

AIM

This course aims to develop the skills of the students in the area of process Modelling and simulation.

OBJECTIVES

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

- Basics of Modelling.
- Modelling of chemical engineering systems.
- Dynamic simulation.

UNIT I **9**

BASICS OF MODELLING

Principles of formulation, Fundamental laws – continuity equation, Energy equation, Equations for motion, Transport equation, Equations of state, Equilibrium, Chemical kinetics.

UNIT II **9**

MODELLING OF CHEMICAL ENGINEERING SYSTEMS – I

CSTR – Series of isothermal, Constant – Holdup CSTR, CSTR with variable hold up, Two heated tar, Gas phase, Pressurized CSTR, Non-isothermal CSTR, Single component vapourizer.

UNIT III **9**

MODELLING OF CHEMICAL ENGINEERING SYSTEMS – II

Batch reactor, Reactor with mass transfer, Single component vapourizer, Multi component flash drum, Ideal binary distillation column, Multi component non-Ideal distillation column, Batch distillation with holdup.

UNIT IV **9**

DYNAMIC SIMULATION – I

Batch reactor, Gravity flow tank, Three CSTR in series, Non-iso thermal CSTR.

UNIT V **9**

DYNAMIC SIMULATION – II

Binary distillation and multi component distillation column, Variable pressure distillation, Ternary batch distillation with holdup.

Total : 45 Hours

OUTCOMES

- Understand the important physical phenomena from the problem statement
- Develop model equations for the given system
- Demonstrate the model solving ability for various processes/unit operations
- Demonstrate the ability to use a process simulation

TEXT BOOKS

1. William L. Luyben, 1990. Process Modelling, Simulation and Control for Chemical Engineers , 2nd Edn., *Mc Graw Hill Iinternational Editions*, New York.
2. Davis, M.E., 1984. Numerical Methods and Modelling for Chemical Processes. *Wiley*, New York.

REFERENCES

1. Bisio, A. and Robert L. Kabel, 1985. Scale-up of Chemical Processes. *Wiley*, New York.
2. Dewn, M.M., 1986. Process Modelling, *Wiley*, New York.
3. Finlasyson, B.A., 1980. Non Linear Analysis in Chemical Engineering. *McGraw Hill*, New York.
4. Babu, B. V., 2004. Process Plant Simulation. *Oxford University Press*.
5. Tanase Gh. Dobre and Jose G. Sanchez Marcano, 2007. Chemical Engineering : Modelling, Simulation and Similitude.

		L	T	P	C
ELECTIVE	**BIOREACTOR THEORY**	**3**	**0**	**0**	**3**

AIM

To impart more knowledge about Bioreactors.

OBJECTIVES:

1. To enhance skills in the areas of biochemical processes,
2. To provide the fundamental background of bioreactor principles, its design, types of bioreactors, its design and modelling

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

OUTCOMES:

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.

TEXT BOOKS

1. Pauline M. Doran, 2002. Bioprocess Engineering Principles. *Academic Press*.
2. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering
    a. 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*.

		L	T	P	C
ELECTIVE	**BIOREACTOR DESIGN**	**3**	**0**	**0**	**3**

AIM:

To understand the relevance and the art of Bioreactor design and operation according to the applied microbial culture, basic chemical and biochemical engineering principles and modes of operation.

OBJECTIVES

To have a in-depth knowledge in

- The Fermentation technology, kinetics and sterilization of bioreactors
- Material and energy balance in fermentation process.
- Mass transfer in Bioreactors and scale-up
- Types of bioreactors
- Bioreactor control systems

UNIT I **9**

FERMENTATION

Fermentation Technology – Medium formulation, Design and operation of a fermentation process, Batch, Fed batch, Continuous and chemostat principles and the modes of operation. Sterilization of reactors – Batch sterilization, Continuous sterilization.

UNIT II **9**

MATERIAL AND ENERGY BALANCES

Material Balance – General mass balance – Stoichiometry of growth and product formation, Growth stoichiometry and elemental balances – Electron balances – Biomass yield, Product stoichiometry. Energy balance – General energy balance equations – Enthalpy - Enthalpy change in non reactive processes – Enthalpy change due to reaction– Energy balance equation for cell culture.

UNIT III **9**

MASS TRANSFER IN BIOLOGICAL SYSTEMS

Mass and heat transport processes – Rheological properties of fermentation broths, Fluid dynamics, Mixing equipment – The impellers in bioreactors – Pneumatic mixing and circulation pumps, Liquid flow models, Power requirements for mixing, Scale-up of mixing systems, Heat and mass transport in liquid substrates.

UNIT IV **9**

BIOREACTOR TYPES

Types of bioreactors, Immobilized bioreactor, Packed-bed bioreactor, Bubble-column bioreactors,

Fluidized bed bioreactors, Trickle bed bioreactors, Membrane bioreactors and fine product bioreactors, Large-scale bioreactors, Photo bioreactors for plant cells and algae cultivations, Solid state substrate bioreactors and bioreactor design, Reactors for large scale production using animal cells.

UNIT V **9**

BIOREACTOR CONTROL SYSTEMS

Bioreactor on-line, In-line and off-line instrumentation control – Physical and chemical sensors for the medium and gases, On-line sensors for cell properties, Off-line analytical methods, Computers and interfaces, Data analysis, Process control, Advanced control strategies, Optical and biosensors, Bioreactor case studies.

Total : 45 Hours

OUTCOMES:

1. Use knowledge of advanced calculus and the maximum principles to design and analyze reactors.
2. Design biological reactors with cell recycle streams.
3. Apply the reactor optimization principles for the design of bioreactors for industrially important biological products, primary and secondary products.
4. Apply the reactor optimization principles for biological treatment of wastewater.

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*.

Scragg A. H., 1991. Bioreactors in Biotechnology, *Ellis Horwood series*.

		L	T	P	C
ELECTIVE	**ENVIRONMENTAL BIOTECHNOLOGY**	**3**	**0**	**0**	**3**

AIM

To understand the role of Microorganisms and Biotechnology in combating the various aspects of Environmental pollution.

OBJECTIVES

To discuss in detail about the

- Ecosystems concept and function.
- Environmental pollution and its management.
- Treatment of industrial wastes.
- Environmental issues and protection act.
- Human population and value education.

UNIT I **11**

ENVIRONMENT AND ITS COMPONENTS AND FUNCTION

Definition, Scope – Objective and importance, Concept of ecosystem – Types (Water, Air and Land), Ecological adaptation, Structure and function of an ecosystem – Biogeochemical cycle – Producers, Consumers, Decomposers, Energy flow in the ecosystem, Food chain, Food web and Ecological pyramids and its importance. Biodiversity – Concept – Values of biodiversity, Endangered and Endemic species in India, Hot spots of biodiversity – Threads to biodiversity, Sustainable development, Conservation – *In situ* and *Ex-situ.*

UNIT II **9**

ENVIRONMENT AL POLLUTION AND ITS MANAGEMENT

Definition – Causes, Effect and Control measures of Air, Water, Soil, Noise, Thermal and Nuclear pollution, Soil waste Management. Design and modelling of activated sludge process, Mathematical modelling of anaerobic - Digested dynamics

UNIT III

TREATMENT OF INDUSTRIAL WASTE

Treatment of industrial waste – Dairy, Pulp, Dye, Leather and Pharmaceuticals. Recent development pertaining to Environment biotechnology.

UNIT IV **9**

ENVIRONMENTAL ISSUES AND PROTECTION ACT

Existing environmental issue – Changing climates, Global warming, Acid rain, Green house effect, Ozone layer depletion, Global, National and Regional laws governing environment, Report

preparation regarding environmental Changes / Case studies.

UNIT V **8**

HUMAN POPULATION AND VALUE EDUCATION

Population growth, Variation among Nations – Population explosion – Family welfare program – Environment and human health – Human rights – Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health – Case studies.

Total : 45 Hours

OUTCOMES:

Students will be able to:

1. explain the importance of microbial diversity in environmental systems, processes and biotechnology as well as the importance of molecular approaches in environmental microbiology and biotechnology
2. describe existing and emerging technologies that are important in the area of environmental biotechnology
3. implement a range of practical approaches relevant to environmental microbiology and biotechnology and record, report and discuss data

TEXT BOOKS

1. Jogdand, S.N., 2003. Environmental Biotechnology. 2nd Edn., *Himalaya Publishing House*, Mumbai. Website : WWW. Himpub.com.
2. Dhameja, S.K., 1999. Environmental Engineering and Management. *S.K. Kataria and Sons*, New Delhi.
3. Sharma, B.K. Environmental Chemistry.

REFERENCES

1. Masters, J.G., 1997. Introduction of Environmental Engineering and Science. *Prentice Hall*, New Delhi.
2. Stainr, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, R.R., 1989. General Microbiology. *Mac Millan Publications.*
3. Foster, C.F. and John Ware, D.A., 1987. Environmental Biotechnology. *Ellis Honwood Ltd*.
4. Karnley, D., Chakrabarty, K. and Omen, G.S., 1989. Biotechnology and Biodegradation, Advances in Applied Biotechnology. *Gulf Publications Co.*, London.
5. Sharma, P. D., 2005. Environmental Science. *Rastogi Publication*.

		L	T	P	C
ELECTIVE	**BIOBUSINESS AND BIOENTREPRENEURSHIP**	**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
- Understanding biotech invention and the FDA approval process
- Biotech demand and investment
- Risk management considerations for Biotech investors
- R & D for entrepreneurship

UNIT I **9**

ENTREPRENEURSHIP IN BIOTECHNOLOGY

Why Biotech? , Biotechnology innovations benefits society, Pharma and Biotech Industry, Entrepreneurship in Biotechnology, What is bioentrepreneurship?, Profiling the bioentrepreneur, Intellectual capital in Biotech firms, Global healthcare markets in Biotechnology.

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 investing, The industry life cycle, Biotechnology investment trading rules, Bioindustry – Global and Indian Scenario, Policy Environment of Biotech Industries in India. Government funding for Biotechnology, Venture capital financing of Biotechnology, Perceptional analysis of biotech companies (A case study).

UNIT IV **9**

RISK MANAGEMENT CONSIDERATIONS FOR BIOTECH INVESTORS

Retention of position and Associated Risk, Liquidation of position 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 development 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

OUTCOMES:

- Students in the Entrepreneurship emphasis of the Business Management major acquire the knowledge and, more importantly, develop the skills and competencies necessary to engage in entrepreneurship throughout their lives.
- Whether through starting new ventures or managing in existing firms, Entrepreneurship students solve problems through innovation.

TEXT BOOKS

1. Mark Tang C., 2007. The Essential Biotech Investment Guide , *World Scientific*
2. Damina H. and John K., 2006. Innovations and Entrepreneurship 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 Financing for Biotechnology. Concept Publishing Company.
3. Alain Vert's, Nasib Qureshi, Hideaki Yukawa and Hans Blascheck, 2007. Biomass to Biofuels : Strategies for Global Industries. *Wiley & Sons.*
4. Bioentrepreneurship : Building a Biotechnology Company from the Ground Up.1998. *Nature Biotechnology,* Volume 16.
5. Joseph Alper, 1999. Bioentrepreneurship: Maintaining Financial Stability, *Nature Biotechnology*.

		L	T	P	C
ELECTIVE	**PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT**	**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.

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

OUTCOMES

On completion of this subject the students 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

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*.
5. Rudd and Watson, 1987. Strategy for Process Engineering, *Wiley Publications*.

		L	T	P	C
ELECTIVE	**CYBER SECURITY**	**3**	**0**	**0**	**3**

AIM

To study the critical need for ensuring security in real time problems.

OBJECTIVES

The students are introduced to

- The basics of Cyber security.
- Various attacker techniques.
- Legal, ethical and professional issues.
- Malicious code.
- Defence and analysis techniques

UNIT I **9**

CYBER SECURITY FUNDAMENTALS

Network and security concepts – Basic cryptography – Symmetric encryption – Public key Encryption – DNS – Firewalls – Virtualization – Radio frequency identification – Microsoft windows security principles.

UNIT II **9**

ATTACKER TECHNIQUES AND MOTIVATIONS

Antiforensics – Tunneling techniques – Fraud techniques – Threat infrastructure.

UNIT III **9**

EXPLOITATION

Techniques to gain a foot hold – Misdirection, Reconnaissance and disruption methods.

UNIT IV **9**

MALICIOUS CODE

Self replication Malicious code – Evading detection and elevating privileges – Stealing information and exploitation.

UNIT V **9**

DEFENCE AND ANALYSIS TECHNIQUES

Memory forensics – Honeypots – Malicious code naming – Automated malicious code analysis systems – Intrusion detection systems – Defense special file investigation tools.

Total : 45 Hours

OUTCOMES:

Having successfully completed this subject, students will be able to demonstrate knowledge and understanding of:

- The importance of taking a multi-disciplinary approach to cyber security
- The cyber threat landscape, both in terms of recent emergent issues and those issues which recur over time
- The roles ad influences of governments, commercial and other organisations, citizens and criminals in cyber security affairs
- General principles and strategies that can be applied to systems to make them more robust to attack
- Key factors in cyber security from different disciplinary views including computer science, management, law, criminology and social sciences
- Issues surrounding privacy, anonymity and pervasive passive monitoring

TEXT BOOK

1. James Graham, Richard Howard and Ryan Olson, 2011. Cyber Security Essentials. *CRC Press, Taylor & Francis Group*.

REFERENCES

1. Dan Shoemaker, William Arthur Conklin and Wm Arthur Conklin, 2012. Cybersecurity : The Essential Body of Knowledge. *Cengage Learning*.

2. Ali Jahangiri, "Live Hacking: The Ultimate Guide to hacking Techniques & Counter measures for Ethical Hackers & IT Security Experts", 2009.

		L	T	P	C
ELECTIVE	**PROFESSIONAL ETHICS IN ENGINEERING**	**3**	**0**	**0**	**3**

AIM

To sensitize the engineering students on blending both technical and ethical responsibilities.

OBJECTIVES

The students acquire knowledge to

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

UNIT I **9**

ENGINEERING ETHICS

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II **9**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III **9**

ENGINEER'S RESPONSIBILITY FOR SAFETY

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV **9**

RESPONSIBILITIES AND RIGHTS

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 **9**

GLOBAL ISSUES

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics – Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership –

Sample Code of Conduct.

Total : 45 Hours

OUTCOMES:

Upon completion of this course, the student would be able

- To understand the ethics and responsibility for safety
- To create awareness for the professional responsibilities and rights
- To offer the importance of intellectual property rights for the technologies

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", *McGraw Hill, New York* (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", *Thompson Learning*, (2000).

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", *Prentice Hall, New Mexico*, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", *Pearson Education*, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", *Oxford University Press*, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agarwal, "Business Ethics – An Indian Perspective",*Biztantra, New Delhi*, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", *Oxford University Press*, (2003)