

# ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2009

M.TECH. BIOTECHNOLOGY

I SEMESTER (FULL TIME) CURRICULUM AND SYLLABI

## SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	BT 9250 BT 9251 BT 9252	<a href="#">Molecular Fundamentals in biology</a> * <a href="#">Fundamentals of chemical engineering</a> ** <a href="#">Enzyme technology and Industrial applications</a> ***	3	0	0	3
2	BT 9211	<a href="#">Biochemical engineering and Fermentation Technology</a>	3	0	0	3
3	BT 9212	<a href="#">Computational Biology</a>	2	0	2	3
4	BT 9213	<a href="#">IPR and Biosafety</a>	3	0	0	3
5	E1	Elective 1	3	0	0	3
6	E2	Elective 2	3	0	0	3
7	E3	Elective 3	3	0	0	3
<b>PRACTICAL</b>						
8	BT 9214	<a href="#">Preparative and analytical techniques in biotechnology</a>	0	0	6	3
<b>TOTAL</b>			<b>20</b>	<b>0</b>	<b>8</b>	<b>24</b>

\* Is meant for students who have (Non-BioTech) B.E / B. Tech. degree

\*\* Is meant for students who have (Science and Biology) M.Sc. degree

\*\*\*Is meant for students who have (Bio Technology) B.Tech.degree

## ELECTIVES FOR M.TECH. BIOTECHNOLOGY

### SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	BT 9253	<a href="#">Applied Mathematics for Biotechnologists</a>	3	0	0	3
2	BT 9254	<a href="#">Applicable Mathematics for Biotechnologists</a>	3	0	0	3
3	BT 9255	<a href="#">Unix Operating System and Programming Language C++</a>	3	0	0	3
4	BT 9256	<a href="#">Food Processing and Biotechnology</a>	3	0	0	3
5	BT 9257	<a href="#">Pharmaceutical Biotechnology</a>	3	0	0	3
6	BT 9258	<a href="#">Environmental Biotechnology</a>	3	0	0	3
7	BT 9259	<a href="#">Communication skills and personality development</a>	3	0	0	3

**UNIT I INTRODUCTION TO BIOLOGICAL MOLECULES 9**  
Basic Carbon Chemistry, Types of biomolecules, Molecular structure and function of Biological Macromolecules - Proteins, Nucleic acids, Carbohydrates, Lipids

**UNIT II GENES TO METABOLIC END-PRODUCTS 9**  
Basics of DNA replication, transcription, translation, biocatalysis, pathways and metabolism

**UNIT III MOLECULAR CELL BIOLOGY AND ENERGETICS 9**  
Functional organization of cells at molecular level; membranes, molecular communication across membranes, energetics – proton motive force, ATP synthesis, respiration; photosynthesis

**UNIT IV MOLECULAR BASIS OF MICROBIAL FORMS AND THEIR DIVERSITY 9**  
Structural differences between different microbial cell types; over view of primary and secondary metabolism of microbes, commercial products like antibiotics, vitamins from microbes

**UNIT V MOLECULAR BASIS OF HIGHER LIFE FORMS 9**  
Molecular differences between various eukaryotic cell types, tissue proteins, blood, important molecular components of blood, albumin, antibodies, hormones and their actions

**TOTAL : 45 PERIODS**

#### TEXT / REFERENCES

1. Interactive Concepts in Biochemistry by Rodney Boyer, Copyright 2002, John Wiley & Sons Publishers, Inc  
<http://www.wiley.com/legacy/college/boyer/0470003790/index.htm>
2. Biochemistry by Lubert Stryer, 5<sup>th</sup> Edition W. H. Freeman and Company, New York
3. Lehninger's Principles of Biochemistry, 4<sup>th</sup> Edn, by David L. Nelson and Michael M. Cox,
4. Molecular Cell Biology, Sixth Edition., by [Harvey Lodish](#), [Arnold Berk](#), [Chris A. Kaiser](#), [Monty Krieger](#), [Matthew P. Scott](#), [Anthony Bretscher](#), [Hidde Ploegh](#), [Paul Matsudaira](#)
5. Bioenergetics at a Glance: An Illustrated Introduction [D. A. Harris](#), 1995 John Wiley & Sons Publishers, Inc
6. Introduction to General, Organic, and Biochemistry, 8th Edition Morris Hein, Leo R. Best, Scott Pattison, Susan Arena 2004, John Wiley & Sons Publishers, Inc
7. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology Michael Wink (Editor) 2006 John Wiley & Sons Publishers, Inc

**UNIT I INTRODUCTION****5**

Introduction to chemical engineering sciences and its role in the design & analysis of chemical processes. Overview of unit operations and processes in the chemical industry. Units and conversion factor. Introduction to Dimensional analysis.

**UNIT II MATERIAL AND ENERGY BALANCES****13**

Overall and component material balances - Material balances without chemical reactions - Chemical reactions - stoichiometry - conversion and yield - Material balance calculations with chemical reactions – combustion calculations - recycle operations. Energy balances - Entropy - Latent heat - Chemical reactions - combustion. Concepts of chemical thermodynamics, the relation to VLE, solution thermodynamics and reaction thermodynamics.

**UNIT III FLUID MECHANICS****9**

Properties of fluids; Fluid statics – forces at fluid surfaces, Pressure and measurement of pressure differences; Fluid flow concepts and basic equations of fluid flow – continuity equation and Bernoulli's equation; shear stress relationship and viscous effects in fluid flow; non newtonian fluids; significance of dimensionless groups in fluid flow operations.

**UNIT IV TRANSPORTATION OF FLUIDS****9**

Different types of pumps, compressors and valves. Measurement of fluid flow using hydrodynamic methods, direct displacement method. Types of agitators, flow patterns in agitated vessels, calculation of power consumption – applications in bioreactor design

**UNIT V HEAT TRANSFER****9**

Nature of heat flow - Conduction, convection, radiation. Steady state conduction, Principles of heat flow in fluids, Heat transfer by forced convection in laminar and turbulent flow. Heat exchange equipments- principles and design.

**TOTAL : 45 PERIODS****REFERENCES**

1. Bhatt B.I., Vora S.M. Stoichiometry. 3<sup>rd</sup> ed., Tata McGraw-Hill, 1977.
2. McCabe W.L., *et al.*, Unit Operations In Chemical Engineering. 6<sup>th</sup> ed., McGraw-Hill Inc., 2001.
3. Geankoplis C.J. Transport Processes And Unit Operations. 3<sup>rd</sup> ed., Prentice Hall India, 2003.

**UNIT I            KINETICS AND MECHANISM OF ENZYME ACTION            8**

Classification of enzymes; quantification of enzyme activity and specific activity. Estimation of Michaelis Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple substrate reactions.

**UNIT II            IMMOBILISED ENZYME REACTIONS            9**

Techniques of enzyme immobilisation-matrix entrapment, ionic and cross linking, column packing; Analysis of mass transfer effects of kinetics of immobilised enzyme reactions; Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized enzyme reactions; calculation of Effectiveness Factors of immobilized enzyme systems; Bioconversion studies with immobilized enzyme packed -bed reactors.

**UNIT III            MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS            5**

Analysis of film and Pore diffusion Effects on kinetics of immobilised enzyme reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors

**UNIT IV            APPLICATION OF ENZYMES            12**

Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes. Use of enzymes in analysis-types of sensing-gadgetry and methods. Case studies on application - chiral conversion, esterification etc.,

**UNIT V            ENZYME BIOSENSORS            11**

Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997 Lee, James M. Biochemical Engineering, PHI, USA.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2<sup>nd</sup> Ed., McGraw Hill, 1986
3. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3<sup>rd</sup> ed., Ellis Harwood 1995.

**UNIT I          INTRODUCTION TO BIOPROCESSES:** **5**

Historical development of bioprocess technology, An overview of traditional and modern applications of biotechnological processes, general requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes.

**UNIT II          METABOLIC STOICHIOMETRY AND ENERGETICS** **8**

Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

**UNIT III          MEDIA DESIGN FOR FERMENTATION PROCESSES** **12**

Medium requirements for fermentation processes, Carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media. Medium for plant cell culture and animal cell culture. Medium design of commercial media for industrial fermentations – Plackett burman design, response surface methodology, simplex design, continuous cultivation method to determine the kinetic parameters and maintenance coefficient and pulse & shift method of medium optimization. Case studies on each medium design methods.

**UNIT IV          KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION** **10**

Phases of cell growth in batch cultures, Fed batch and continuous cultures. Simple unstructured kinetic models for microbial growth, Monod model, Growth of filamentous organisms & yeast. Growth associated (primary) and non-growth associated (secondary) product formation kinetics, Leudeking-Piret models, substrate and product inhibition on cell growth and product formation.

**UNIT V          FERMENTATION TECHNOLOGY** **10**

Case studies on production of Lactic acid, Glutamic acid, Pencillin, Microbial Lipase and Protease, Recombinant Insulin. Case studies should deal with strain improvement, medium designs, process optimization etc.,

**TOTAL : 45 PERIODS**

**REFERENCES**

1. Bailey, J.E. and Ollis, D.F. Biochemical Engineering Fundamentals", 2<sup>nd</sup> ed., McGraw Hill 1986.
2. Shuler, M.L. and Kargi, F. Bioprocess Engineering : Basic concepts, 2<sup>nd</sup> ed., Prentice-Hall, 2002.
3. Doran Pauline M, Bioprocess Engineering Principles, Academic Press, 1995
4. Stanbury, P.F., Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

<b>UNIT I</b>	<b>INTRODUCTION TO COMPUTATIONAL BIOLOGY</b>	<b>7</b>
Molecular sequences. Sequence analysis. Dynamic programming. Pairwise and multiple sequence alignment and motifs. Applications.		
<b>UNIT II</b>	<b>DATABASES</b>	<b>6</b>
Scoring matrices, heuristic methods of database searching: BLAST family of programs, FASTA. Phylogenetic trees.		
<b>UNIT III</b>	<b>INTRODUCTION TO GENOMICS AND PROTEOMICS</b>	<b>10</b>
Functional, structural and comparative genomics. Gene finding and annotation. Protein structure. Homology modeling. Differential gene expression.		
<b>UNIT IV</b>	<b>MACHINE LEARNING TECHNIQUES</b>	<b>12</b>
Hidden Markov models, Neural nets, Decision trees and their application in computational biology. Eukaryotic and prokaryotic gene finding. DNA Computing.		
<b>UNIT V</b>	<b>INTRODUCTION TO PERL</b>	<b>10</b>
Variables, Data types, control flow constructs, arrays, lists and hashes, String manipulation, File handling.		

**LAB:**

Sequence analysis	: Pairwise and multiple sequence alignment. Tools available for sequence analysis. Motif generation.
Databases	: Exploring biological databases
Database searching	: Using BLAST, PSIBLAST and PHIBLAST, FASTA.
Gene finding	: Using Genscan, HMMGene etc.
Protein structure	: Tools for protein structure prediction.
Prediction	
Annotation	: Functional annotation. Writing utilities using Perl.

**TOTAL: 60 PERIODS****REFERENCES**

1. Gusfield, Dan. Algorithms on strings Trees and Sequences, Cambridge University Press.
2. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2<sup>nd</sup> ed., East West Press, 2003
3. Mount D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
4. Baxeavanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2<sup>nd</sup> ed., John Wiley, 2002
5. Tisdall, James, Beginning PERL for Bioinformatics, O'Reilley, 2001.6. Durbin, R. et al., Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1998.

**UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY 9**

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies

**UNIT II AGREEMENTS AND TREATIES 9**

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

**UNIT III BASICS OF PATENTS AND CONCEPT OF PRIOR ART 9**

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTSCOPE(WIPO), IPO, etc.)

**UNIT IV PATENT FILING PROCEDURES 9**

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

**UNIT V BIOSAFETY 9**

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

**TOTAL : 45 PERIODS****TEXTS/REFERENCES**

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

1. Preparation of Acetate, Tris and Phosphate Buffer systems and validation of Henderson-Hasselbach equation.
2. Reactions of amino acids – Ninhydrin, Pthaldehyde, Dansyl chloride – measurement using colorimetric and fluorimetric methods.
3. Differential estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose
4. Estimation of protein concentration using Lowrys' method, Dye-binding method
5. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect
6. Separation of lipids by TLC.
7. Enzyme Kinetics: Direct and indirect assays – determination of  $K_m$ ,  $V_{max}$  and  $K_{cat}$ ,  $K_{cat}/K_m$ .
8. Restriction enzyme – Enrichment and unit calculation
9. Ion-exchange Chromatography – Purification of IgG and Albumin
10. Gel filtration – Size based separation of proteins
11. Affinity chromatography – IMAC purification of His-tagged recombinant protein
12. Assessing purity by SDS-PAGE Gel Electrophoresis
13. Chemical modification of proteins – PITC modification of IgG and Protein immobilization

**TOTAL : 90 PERIODS**

#### **REFERENCES**

1. Biochemical Methods: A Concise Guide for Students and Researchers, Alfred Pingoud, Claus Urbanke, Jim Hoggett, Albert Jeltsch, 2002 John Wiley & Sons Publishers, Inc,
2. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, Irwin H. Segel, 1976 John Wiley & Sons Publishers, Inc,
3. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.



**BT 9221**

**BIOSEPARATION TECHNOLOGY**

**L T P C**

**3 0 0 3**

**UNIT I INTRODUCTION TO BIOSEPARATION**

**4**

Characterization of biomolecules and fermentation broth. Guidelines to recombinant protein purification.

**UNIT II SOLID-LIQUID SEPARATION AND CELL DISRUPTION**

**6**

Solid liquid separation- microfiltration and centrifugation – theory and design for scaleup operation. Cell disruption – Homogeniser , dynamill – principle, factors affecting disruption, batch and continuous operation. Cell disruption by chemical methods.

**UNIT III CONCENTRATION AND PURIFICATION**

**7**

Liq- liq extraction – theory and practice with emphasis on Aqueous two phase extraction. Solid liquid extraction. Precipitation techniques using salt and solvent. Separation by ultrafiltration, Dialysis, Electrophoresis.

**UNIT IV CHROMATOGRAPHY**

**15**

Theory, practice and selection of media for – Gelfiltration chromatography, Ion exchange chromatography, Hydrophobic interaction chromatography, reverse phase chromatography, Affinity chromatography – Metal affinity chromatography, dye affinity chromatography, immunosorbent affinity chromatography & Expanded bed chromatography. Scaleup criteria for chromatography, calculation of no of theoretical plates and design

**UNIT V FINAL POLISHING AND CASE STUDIES**

**13**

Freeze drying, spray drying and crystallization. Purification of cephalosporin, aspartic acid, Recombinant Streptokinase, Monoclonal antibodies, Tissue plasminogen activator, Taq polymerase, Insulin.

**TOTAL : 45 PERIODS**

**REFERENCES**

1. Belter,P.A. et al., Bioseparations: Downstream Processing For Biotechnology, John-Wiley , 1988
2. Janson J.C, & Ryden L. Protein Purification: Principles, High Resolution Methods And Applications, VCH Pub. 1989.
3. Scopes R.K. – Protein Purification – Principles And Practice, Narosa , 1994.

**BT 9222**

**ADVANCED GENETIC ENGINEERING**

**L T P C**

**3 0 0 3**

**UNIT I CLONING AND EXPRESSION OF GENES**

**10**

Cloning vehicles, restriction enzymes, restriction modification, linkers, adaptors, homopolymeric trailing, restriction mapping

Expression and purification of recombinant proteins, prokaryotic and eukaryotic expression vectors, in vivo homologous recombination, large scale expression and purification of proteins.

**UNIT II LIBRARY CONSTRUCTION**

**8**

cDNA & genomic DNA library construction and screening, preparation of DNA, RNA probes immunoscreening and blotting techniques, etc

**UNIT III SEQUENCING 10**  
Methodology – Chemical & enzymatic, Automated sequence, Genome sequencing methods – top down approach, bottom up approach.

**UNIT IV PCR AND MUTAGENESIS 7**  
PCR principle, applications, different types of PCR, mutagenesis and chimeric protein engineering by PCR, RACE, Kuntels' method of mutagenesis.

**UNIT V GENE TRANSFER & GENE THERAPY 10**  
Introduction of foreign genes into plant and animal cells, creation of transgenic plants and animal knockouts, gene therapy, types and vectors.

**TOTAL : 45 PERIODS**

**REFERENCES**

1. Primrose S.B., Twyman R.H. and Old R.W. Principles of Gene Manipulation, 6<sup>th</sup> ed., Blackwell Science, 2001
2. Winnacker E.L. From Genes to clones : Introduction to Gene Technology, Panima, 2003
3. Glick B.R. and Pasternak J.J. Molecular Biotechnology: Principles and applications of recombinant DNA, 3<sup>rd</sup> ed., ASM Press, 2003
4. Lemonie, N.R. and Cooper, D.N. Gene therapy, BIOS Scientific, 1996

**BT 9223 IMMUNOTECHNOLOGY L T P C  
3 0 0 3**

**UNIT I INTRODUCTION 12**  
Cells of the immune system and their development; primary and secondary lymphoid organs; humoral immune response; cell mediated immune responses; complement.

**UNIT II ANTIBODIES 10**  
Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay; Plaque Forming Cell Assay.

**UNIT III CELLULAR IMMUNOLOGY 12**  
PBMC separation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing.

**UNIT IV VACCINE TECHNOLOGY 6**  
Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology

**UNIT V DEVELOPMENT OF IMMUNOTHERAPEUTICS: 5**  
Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation.

**TOTAL : 45 PERIODS**

## REFERENCES

1. Roitt, Ivan. Essential Immunology, 9<sup>th</sup> ed., Blackwell Scientific, 1997
2. Roitt I., Brostoff J. and Male D. Immunology, 6<sup>th</sup> ed. Mosby, 2001
3. Goldsby , R.A., Kindt, T.J., Osborne, B.A. and Kerby J. Immunology, 5<sup>th</sup> ed., W.H. Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8<sup>th</sup> ed., Cheerchill, Linvstone, 1997

**BT 9224**

**ANIMAL BIOTECHNOLOGY**

**L T P C  
3 0 0 3**

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>4</b>
Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins.		
<b>UNIT II</b>	<b>MOLECULAR BIOLOGY</b>	<b>9</b>
Biology of animal viral vectors- SV40, adeno virus, retrovirus, vaccinia virus, herpes virus, adeno associated virus and baculo virus.		
<b>UNIT III</b>	<b>CELL CULTURE TECHNOLOGY</b>	<b>11</b>
Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture-mono-layer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, Chemostat/Turbidostat; High technology vaccines; Hybridoma technology; Cell lines and their applications		
<b>UNIT IV</b>	<b>GENETIC ENGINEERING</b>	<b>11</b>
Gene therapy-prospects and problems; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications.		
<b>UNIT V</b>	<b>APPLICATIONS</b>	<b>10</b>
Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming -Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.		

**TOTAL : 45 PERIODS**

## REFERENCES

1. Watson, J.D., Gilman, M., Witowski J. and Zoller, M. Recombinant DNA, 2<sup>nd</sup> ed., Scientific American Books, 1983
2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3<sup>rd</sup> ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004
4. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 1998
5. Freshney R.I. Animal Cell Culture- a practical approach, 1987

1. Sterilization, disinfection, safety in microbiological laboratory.
2. Preparation of media for growth of various microorganisms.
3. Identification and culturing of various microorganisms.
4. Staining and enumeration of microorganisms.
5. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
6. Selection of animals, Preparation of antigens, Immunization and methods of bleeding, Serum separation, Storage.
7. Antibody titre by ELISA method.
8. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
9. SDS-PAGE, Immunoblotting, Dot blot assays
10. Blood smear identification of leucocytes by Giemsa stain
11. Separation of mononuclear cells by Ficoll-Hypaque
12. Immunodiagnosics using commercial kits

**TOTAL : 90 PERIODS**

1. Preparation of Genomic DNA
2. PCR amplification of gene from the genomic DNA
3. Preparation of plasmid DNA
4. Restriction Digestion of the vector and Insert
5. Ligation and Transformation to E.coli
6. Lysate PCR confirmation.
7. Restriction & gel elution of DNA fragments
8. Electroporation to Yeast
9. Induction experiments in E.coli using IPTG, salt etc
10. SDS-PAGE analysis of expression
11. Western blot confirmation of expressed protein (anti his)
12. ELISA (anti his) – Quantification of expressed protein.
13. RNA Isolation
14. cDNA preparation from RNA
15. Site directed mutagenesis
16. Southern hybridization experiment

**TOTAL : 90 PERIODS**

**BT 9232**

**ADVANCED BIOPROCESS AND DOWNSTREAM  
PROCESSING LAB**

**L T P C  
0 0 6 3**

1. Enzyme kinetics, inhibition, factors affecting reaction ph, temp.
2. Enzyme immobilization studies – Gel entrapment, adsorption and ion exchange immobilisation.
3. Optimization techniques – Plackett burman, Response surface methodology.
4. Batch cultivation – recombinant *E.coli* – growth rate, substrate utilization kinetics, plasmid stability, product analysis after induction, Metabolite analysis by HPLC
5. Fed batch cultivation *E.coli*, *Pichia pastoris*
6. Continuous cultivation – x - d construction, kinetic parameter evaluation, gas analysis, carbon balancing, Pulse and shift techniques.
7. Bioreactor studies : Sterlisation kinetics,  $k_{La}$  determination, residence time distribution
8. Animal cell culture production: T-flask, spinner flask, bioreactor
9. Cell separation methods; Centrifugation and microfiltration
10. Cell disruption methos: Chemical lysis and Physical methods
11. Product concentration: Precipitation, ATPS, Ultrafiltration
12. High resolution purification; Ion exchange, affinity and Gel filtration
13. Freeze drying

**TOTAL : 90 PERIODS**

**BT 9253**

**APPLIED MATHEMATICS FOR BIOTECHNOLOGISTS**

**L T P C  
3 0 0 3**

- UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9**  
First order and second order-application to biology.Lagrange's method and Charpits method.
- UNITII PROBABILITY AND STATISTICS 9**  
Probability –Addition theorem, Multiplication theorem and conditional probability-Baye's theorem. Binomial distribution, Poisson distribution and Normal distribution.
- UNIT III CURVE FITTING 9**  
Curve fitting –fitting a straight line and second degree curve. Correlation and Regression. Fitting a non linear curve. Bivariate correlation application to biological sciences.
- UNITIV SAMPLING DISTRIBUTIONS 9**  
Sampling distributions-Large samples and Small samples. Testing of Null hypothesis-Z test, t test and  $\chi^2$  test. Type I and Type II errors. Fisher's F Test. Goodness of fit.
- UNIT V DESIGN OF EXPERIMENTS 9**  
Design of Experiments –One way, Two way classifications – Randomied Block Designs-Latin Square Designs.

**TOTAL : 45 PERIODS**



## TEXTS/REFERENCES

1. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, ISE Reprint, Addison-Wesley, 1998.
2. E. Kreyszig, Advanced engineering mathematics, 8th Edition, John Wiley, 1999.
3. W. E. Boyce and R. DiPrima, Elementary Differential Equations, 8<sup>th</sup> Edition, John Wiley, 2005.

**BT9255 UNIX OPERATING SYSTEM AND PROGRAMMING LANGUAGE C++**  
**L T P C**  
**2 1 0 3**

**UNIT I UNIX OPERATING SYSTEM 8**

Introduction to Operating Systems, Basic Commands in Unix, vi editor, filters, input/output redirection, piping, transfer of data between devices, shell scripts.

**UNIT II INTRODUCTION TO C++ 10**

Programming methodologies- Introduction to Object Oriented Programming - Comparison of Procedural and Object Oriented languages - Basics of C++ environment, Data types, Control Flow Constructs, Library functions, Arrays

**UNIT III CLASSES 10**

Definition-Data members-Function members-Access specifiers-Constructors-Default constructors-Copy constructors-Destructors-Static members-This pointer-Constant members-Free store operators-Control statements.

**UNIT IV INHERITANCE AND POLYMORPHISM 10**

Overloading operators-Functions-Friends-Class derivation-Virtual functions-Abstract base classes-Multiple inheritance.

**UNIT V TEMPLATES AND FILE HANDLING 7**

Class templates-Function templates-Exception handling- File Handling

**LAB:** Exercises for all the topics.

**TOTAL: 45 PERIODS**

## REFERENCES

1. Kochen, S.J. & Wood, P.H. Exploring the Unix System, Techmedia, 1999
2. Bach M.J., The design of Unix operating systems, Prentice Hall of India, 1999.
3. Lippman S.B., The C++ Primer, Addison Wesley, 1998.
4. Deitel and Deitel, C++ How to Program, Prentice Hall, 1998.
5. Balagurusamy E. ,Object-Oriented Programming using C++, Tata McGraw-Hill, 2002.

**UNIT I FOOD CHEMISTRY 9**  
Constituent of food – contribution to texture, flavour and organoleptic properties of food; food additives – intentional and non-intentional and their functions; enzymes in food processing.

**UNIT II FOOD MICROBIOLOGY 9**  
Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases – infections and intoxications, food spoilage – causes.

**UNIT III FOOD PROCESSING 9**  
Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

**UNIT IV FOOD PRESERVATION 9**  
Use of high temperatures – sterilization, pasteurization, blanching, aseptic canning; frozen storage – freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

**UNIT V MANUFACTURE OF FOOD PRODUCTS 9**  
Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

**TOTAL: 45 PERIODS**

#### REFERENCES

1. Coultate T.P. Food – The chemistry of its components, 2<sup>nd</sup> ed., Royal society, London, 1992
2. Sivasankar B. Food processing and preservation, Prentice Hall of India Pvt.Ltd.New Delhi, 2002
3. Fennema O.R. ed. Principles of food science : Part I, Food chemistry, Marcel Dekker, New York, 1976.
4. Frazier W.C. and Westhoff D.C. Food Microbiology, 4<sup>th</sup> ed. McGram-Hill Book Co., New York, 1988
5. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. Food engineering operations, 2<sup>nd</sup> ed., Applied Sciences Pub.ltd., London, 1979
6. Pyke, M. Food Science and Technology , 4<sup>th</sup> ed., John Murray, London, 1981

**UNIT I INTRODUCTION 6**  
History of pharmacy, the pharmaceutical industry & development of drugs; economics and regulatory aspects, quality management; GMP



<b>UNIT II</b>	<b>DRUG KINETICS AND BIOPHARMACEUTICS</b>	<b>9</b>
Mechanism of drug absorption, distribution, metabolism and excretion – factors affecting the ADME process, bioequivalence, pharmacokinetics.		
<b>UNIT III</b>	<b>PRINCIPLES OF DRUG MANUFACTURE</b>	<b>15</b>
Liquid dosage forms – solutions, suspensions and emulsions, Topical applications – ointments, creams, suppositories, Solid dosage forms – powders, granules, capsules, tablets, coating of tablets, Aerosols. Preservation, packing techniques		
<b>UNIT IV</b>	<b>ADVANCES IN DRUG DELIVERY</b>	<b>5</b>
Advanced drug delivery systems – controlled release, transdermals, liposomes and drug targeting		
<b>UNIT V</b>	<b>BIOPHARMACEUTICALS</b>	<b>10</b>
Understanding principles of pharmacology, pharmacodynamics Study of a few classes of therapeutics like laxatives, antacids and drugs used in peptic ulcers, drugs used in coughs and colds, analgesics, contraceptives, antibiotics, hormones.		

**TOTAL : 45 PERIODS**

**REFERENCES**

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

<b>BT 9258</b>	<b>ENVIRONMENTAL BIOTECHNOLOGY</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

<b>UNIT I</b>	<b>OVERVIEW</b>	<b>9</b>
Microbial flora of soil, growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms. Environmental monitoring – sampling, physical, chemical and biological analysis, monitoring pollution		
<b>UNIT II</b>	<b>BIOLOGICAL WASTEWATER TREATMENT</b>	<b>9</b>
Waste water characteristics, The activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, nitrification, secondary treatment using a trickling biological filter, anaerobic digestion, mathematical modeling of anerobic digester dynamics, anaerobic denitrification, phosphate removal		
<b>UNIT III</b>	<b>BIOREMEDIATION</b>	<b>9</b>
Introduction, Inorganic wastes, petroleum based wastes, synthetic organic compounds, phytoremediation, gaseous wastes, desulphurisation of coal and oil.		
<b>UNIT IV</b>	<b>TREATMENT OF INDUSTRIAL WASTES</b>	<b>9</b>
Dairy, pulp, dye, leather, hospital and pharmaceutical industrial waste management. Solid waste management.		
<b>UNIT V</b>	<b>MOLECULAR BIOLOGY</b>	<b>9</b>
Latest elements, developements pertaining to environmental biotechnology.		

**TOTAL: 45 PERIODS**

## REFERENCES

1. Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., General Microbiology, Mcmillan Publications, 1989.
2. Foster C.F., John Ware D.A., Environmental Biotechnology , Ellis Horwood Ltd., 1987.
3. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series , Vol.1, Gulf Publications Co., London, 1989.
4. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2<sup>nd</sup> Ed., McGraw Hill, 1986
5. Alan Scragg., Environmental Biotechnology, Longman.

## BT 9259 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

L T P C

3 0 0 3

### UNIT I PROCESS OF COMMUNICATION 9

Concept of effective communication- Setting clear goals for communication; Determining outcomes and results; Initiating communication; Avoiding breakdowns while communicating; Creating value in conversation; Barriers to effective communication; Non verbal communication- Interpreting non verbal cues; Importance of body language, Power of effective listening; recognizing cultural differences

### UNIT II PRESENTATION SKILLS 12

Formal presentation skills; Preparing and presenting using Over Head Projector, Power Point; Defending Interrogation; Scientific poster preparation & presentation; Participating in group discussions

### UNIT III TECHNICAL WRITING SKILLS 12

Types of reports; Layout of a formal report; Scientific writing skills: Importance of communicating Science; Problems while writing a scientific document; Plagiarism; Scientific Publication Writing: Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts

### UNIT IV COMPUTING SKILLS FOR SCIENTIFIC RESEARCH 12

Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in Scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness

**TOTAL:45 PERIODS**

## TEXT/REFERENCE

Mohan Krishna and N.P. Singh, Speaking English effectively, Macmillan, 2003