

ANNA UNIVERSITY COIMBATORE

M.Sc BIOTECHNOLOGY

CURRICULUM

I SEMESTER

Code No.	Course Title	L	P	M
THEORY				
MBT111	Cell Biology	3	0	100
MBT112	Microbiology	3	0	100
MBT113	Biochemistry	3	0	100
MBT114	Genetics	3	0	100
MBT115	Computer & Mathematics for Biotechnology	3	0	100
MBT116	Instrumentation Techniques	3	0	100
PRACTICAL				
MBT117	Cell Biology, Computer, Instrumentation Lab	0	4	100
MBT118	Microbiology Lab	0	4	100
MBT119	Biochemistry Lab	0	4	100

II SEMESTER

Code No.	Course Title	L	P	M
THEORY				
MBT121	Immunology	3	0	100
MBT122	Molecular Biology & Genetic Engineering	3	0	100
MBT123	Microbial Technology(Basic Industrial Biotechnolgy)	3	0	100
MBT124	Bioprocess Technology	3	0	100
MBT125	Bioinformatics	3	0	100
MBT126	Elective 1	3	0	100
PRACTICAL				
MBT127	Immunology Lab	0	4	100
MBT128	Molecular Biology & Genetic Engineering Lab	0	4	100
MBT129	Bioprocess Technology Lab	0	4	100

III SEMESTER

Code No.	Course Title	L	P	M
THEORY				
MBT231	Enzyme Engineering and Technology	3	0	100
MBT232	Down Stream Processing	3	0	100
MBT233	Plant Biotechnology			
MBT234	Animal Biotechnology			
MBT235	Human values, Professional Ethics and IPR			
MBT236	Elective 2			
PRACTICAL				
MBT237	Enzyme Engineering Lab	0	4	100
MBT238	Plant Biotechnology & Animal Biotechnology Lab	0	4	100
MBT239	Down Stream Processing Lab	1	0	0

IV SEMESTER

Code No.	Course Title	L	P	M
THEORY				
MBT241	Research Methodology & Biostatistics	3	0	100
MBT242	Elective 3	3	0	100
PRACTICAL				
MBT243	Project work	0	8	200

LIST OF ELECTIVES

Code No.	Course Title	L	P	M
Elective 1				
	Pharmaceutical biotechnology	3	0	100
	Cancer biology			
	Microbial Diversity	3	0	100
Elective 2				
	Molecular Pathogenesis	3	0	100
	Environmental Biotechnology	3	0	100
	Food Processing Technolgy	3	0	100
Elective 3				
	Drug Designing	3	0	100
	Developmental Biotechnology	3	0	100
	Metabolic Engineering	3	0	100

Unit-I

Cell theory- origin and evolution of cells. Tools of cell biology-Light microscopy- Electron microscopy-Subcellular fractionation, study of the living cells-Fixation and staining: - freeze drying and freeze substitution. Microtomes & embedding- Chemical basis of staining- metachromatins, cytochemical methods.

Unit-II

Organization of cellular structures- prokaryotes & eukaryotes: Molecular composition of cells- Carbohydrates- Lipids- Nucleic acids- Proteins, Cell membranes-Membrane lipids. Cell wall and extra cellular matrix- cytoskeleton- cell membrane (including plasma membrane)- Endocytosis- Cell-cell interactions. Cell cycle- Mitosis-Meiosis- Regulation of cell cycle- Molecular basis.

Unit-III

Cell organelles-Mitochondria-Plastids-Endoplasmic reticulum- Ribosomes- Endosomes- Golgi-Lysosomes-Peroxisomes-Hydrogenosomes & centrosomes. The cell nucleus: Nuclear envelope- Nucleolus- Chromosomes. Prokaryotic nucleoids(bacterial & plastid genomes).

Unit-IV

Membrane functions; Cell adhesions & cell junctions. Membrane transport- Neurotransmission- Vesicular transport & membrane function(Secretory & endocytic pathways). Membrane proteins- Transport across the membranes.

Unit-V

Cell signaling & cell transduction:- Signalling molecules & their receptors- Functions of cell surface receptors- Pathways of intracellular signal transduction. Signal transduction and cytoskeleton- Development & differentiation- Regulation of programmed cell death.

References:

1. Geoffrey M. Cooper,2000 The Cell A Molecular Approach; 2nd Edition, ASM press, Sinauer Associates, Inc.Washington.
2. Harvey Lodish: Arnold Berk: S.L Zipursky:Paul Matsudaira: David Baltimore and James danell.2000 Molecular Cell Biology; 4th Edition, Media connected, W.H Freeman and company.
3. E.D.P. De Robertis, and E.M.F De Robertis.2001 Cell and Molecular Biology. 8th Edition, Lippincott Williams and Wilkins.

Unit-I

Overview of cell structure- Prokaryotes and Eukaryotes- Cytoplasmic membrane- Structure and function- Cell wall of prokaryotes- Cell wall synthesis and cell division- Flagella and motility- Bacterial behaviour-Cell inclusions- Sterilization techniques- Pure culture techniques- Stains and staining Reactions.

Unit-II

Overview of bacteria: Gram negative- Gram positive(General medical or industrial importance). Actinomycetes- Cyanobacteria- Archeabacteria- Fungi- Slime molds- Water molds- Algae- Protozoa.

Unit-III

General viruses- General properties- Virus host- Quantification of viruses- Virus reproduction (general features)- Virus multiplication. Overview of bacterial viruses- RNA bacteriophages- DNA bacteriophages- Filamentous DNA phages. Lytic cycle & Lysogenic viruses. Overview of animal viruses: RNA viruses, DNA viruses, Herpes viruses, Fox viruses, Adeno viruses, Retro viruses, virioids & Prions.

Unit-IV

Microbial growth- Bacterial growth and reproduction- Phases of growth- Growth rate and kinetics. Batch culture- Continuous culture- Synchronous culture. Factors affecting bacterial growth. Control of microbial growth- Physical control of microorganisms- Chemical control of microorganisms- antibiotics and antimicrobics.

Unit-V

Introduction to Taxonomy. Linnaeus Taxonomy. Five kingdom classification system. Numerical Taxonomy, Genetic homology, other techniques- Classification of viruses- Bacterial Taxonomy and nomenclature.

References:

1. Michael T. Madigan and John M.Martinko and Jack Parker.1997 Biology of Microorganisms Eight Edition Prentice Hall International,Inc
2. Ronald M.Atlas.1997 Principles of Microbiology.WCB MCGraw-Hill
3. Salle. A.J.1971 Fundamental Principles of Microbiology.TMH Edition.
4. Lansing M.Prescott: John P. Harley and Donald A.Klein.2005 Sixth Edition Micribiology McGraw- Hill International Edition

Unit-I

Biomolecules of the cell: Carbohydrates- Classification- Monosaccharides- Disaccharides- Polysaccharides- Homopolysaccharides- Heteropolysaccharides- Glycoproteins. Lipids- Fatty acids- Essential fatty acids- Triglycerides- Phospholipids- Glycolipids- Lipoproteins- Steroids- Aliphatic Lipids.

Unit-II

Proteins- Functions- Amino acids- Properties- Classification. Non-standard amino acids. Structure of proteins- Primary structure- Secondary structure- Tertiary structure- Quaternary structure- Properties of proteins- Classification of proteins.

Unit-III

Nucleic acids- Functions- Nucleotides- Structure of DNA- Chargoff rule- DNA composition- Watson & Crick model of DNA- Structure of RNA.

Unit-IV

Enzymes- Chemical nature & properties- Nomenclature & classifications- Factors affecting enzyme activity- Enzyme specificity- Coenzymes- Mechanism of enzyme action- Regulation of enzyme activities in living system. Units of enzyme activity- Non enzyme protein- Immobilised enzyme- Diagnostic importance of enzyme- soenzyme- Vitamins- Hormones.

Biological oxidation- Oxidation reduction- Bioenergetics- High energetic compounds- Electron transport chain- Substrate level phosphorylation- Oxidative phosphorylation- Free radicals & antioxidants.

Unit-V

Metabolism of carbohydrates- Metabolism of lipids- Metabolism of amino acids- Integration of metabolism- Metabolism of nucleotides & protein synthesis.

References:

1. Nelson, D.L and M.M.Cox. Lehninger. 2005 Principles of Biochemistry, 4th Edition, W.H. Freeman & Company, New York.
2. Sathanarayana, U. 2002 Biochemistry, 2nd Edition, Books & India Co Ltd, Kolkata.
3. Berg, J.M., J.L. Tymoczko & L. Stryer. 2002 4th Edition, W.H. Freeman & Company, New York.

Unit-I

Structural organization of chromosomes- Lampbrush chromosomes- Polytene chromosomes. Mendel & his work- Monohybrid cross- Law of segregation- Dihybrid cross- Genetic interaction. Chromosomal theory of Inheritance. Maternal effects & cytoplasmic Inheritance- Quantitative inheritance.

Unit-II

Cytogenetics- Fine structure of the gene: Cistron, Recon, Muton: Multiple alleles; Lethality & Interaction of genes, Linkage & Crossing over, Genetic mapping of chromosomes, Sex linked inheritance, Sex influenced inheritance, Sex determination, Sex differentiation, Dosage compensation, Genetic imprinting, Karyotyping- Band techniques.

Unit-III

Population genetics- Gene pool, Gene frequency, Hardy Weinberg law- Natural selection, Genetics & Evolution- Conservation of Genetic diversity- speciation.

Unit-IV

Chromosome mutations- Variations in chromosome number & arrangement- DNA structure & analysis- Replication & Recombination- Genetic code. Gene regulation in prokaryotes & eukaryotes- Transposons.

Unit-V

Mutation- Biochemical basis of mutation- Types of mutation- Mutagenesis- Reversion- Suppression- Isolation of mutants- Detection of mutants- Ames test. DNA damage & repair. Hit theory- UV radiation- Biological indication of repair- Thymine dimer- Excision repair- Recombination repair- SOS repair.

References:

1. Gardener, E.J, M.J. Simmons & D.P. Snustad 2003. Principles of Genetics. 8th Edition, John Wiley Sons Inc, New York.
2. Strickberger, M.W 2000. Genetics, 3rd Edition, Prentice Hall of India Pvt Ltd, New Delhi.
3. Klug, W.S & M.K. Cummings 2000. Concepts of Genetics, 6th Edition Prentice Hall, Inc. New Jersey.

MBT 115 Computers & Mathematics for Biotechnology

Unit-I: Fundamentals of Computers & Operating Systems.

Computer Basics- Evolution, Generation, Classification & Applications. Computer organization- CPU. Memory & Storage- Memory Hierachy, RAM, ROM, Types of Secondary Storage Devices. Input/Output Media- Types of I/O devices. Operating system- Evolution, Functions of OS, UNIX & Basic commands. Microsoft Windows XP.

Unit-II: Networking & Internet.

Computer Software- Definitions, Categories, S/W Piracy, S/W Terminologies. Office Automation- Working with word, Spreadsheets, Powerpoint. Networks- Types of N/W. Internet- Evolution, Basic Internet terms, Getting connected to Internet & Applications. Internet Tools- Web browser, E-mail. Search engines. Network Security. Firewalls.

Unit-III: Introduction to Statistics.

Definitions- Measurements, Measurement scales, Variables, Derivded variables, Samples & Populations- Data collection- Primary data, Secondary data- Characteristics of a questionnaire- Precautions in data collection- Accuracy & Precision in data collection- Frequency distributions.

Unit-IV: Descriptive Statistics.

Measures of Central Tendency- Mean, Median, Mode- Measures of Dispersion- Quartile deviation, Mean deviation, Standard deviation- Coefficient of Variation- Binomial Distribution- Poisson Distribution- Normal Distribution- Applications & properties of Normal Distribution.

Unit-V: Estimation & Hypothesis Testing.

.Hypothesis Testing- Definitions- Distribution & varience of means- Confidence limits- Confidence limits- Students't' Test- Difference between two means- F-test- Distribution of the sample proportion- Distribution of the differencebetween two sample proportions- Determination of sample size for estimating means & proportions.

Text Book:

1. Introduction to Information Technology. ITL Education Solutions Limited Pearson Education. 2007
2. Gupta,S.C & V.K.Kapoor. Fundamentals of Mathematical Statistics.
3. Bhagavathy & Pillai- Statistics
4. S.B.Gupta- Statistical Methods
5. M.Manoharan- Statistical Methods.

References:

1. Alexis Leon, Mathews Leon. Fundamentals of Information Technology. Leon Press, Chennai & Vikas Publishing House Pvt Ltd. Delhi.
2. Rajaraman. Fundamentals of Computer. 4th Edition. Prentice Hall India.
3. Sundar Rao & J.Richard. An Introduction to Biostatistics.
4. Pagano.M & K.Gauvreau. Principles of Biostatistics.

Unit-I

Basic principles- Units of measurements- Weak electrolytes. Buffer solutions & their nature & preparations. pH & oxygen electrodes. Safety in the laboratory- Centrifugation: Basic principles- Types- Preparative centrifugation- Analytical centrifugation. Microscopy- Introduction- Light microscope- Phase contrast microscope- Dark field microscope- Fluorescent microscope- Nomasky microscope- Electron microscope.

Unit-II

Chromatographic techniques: Principles- Chromatographic performance parameters- HPLC & LPLC. Adsorption chromatography- Partition chromatography- Ion exchange chromatography- Molecular exclusion- Affinity chromatography- Gas liquid chromatography- Thin layer(planar) chromatography.

Unit-III

Electrophoresis techniques: Principles- Supporting media- Electrophoresis of proteins- Nucleic acids- Capillary electrophoresis- Microchips electrophoresis.

Unit-IV

Atomic & molecular electronic spectroscopy: Principles- UV & Visible spectroscopy- Spectrofluorimetry- Turbidometry- Neplometry- Luminimetry- Atomic spectroscopy- Circular dichroism spectroscopy- X-ray spectroscopy.

Unit-V

Spectroscopic techniques: IR & Raman's spectroscopy- Electron spin resonance spectroscopy- Nuclear magnetic resonance spectroscopy- Mass spectroscopy (Moldi-Tof). Vibrational spectroscopy & electron & nuclear spin orientation in magnetic fields introduction.

References:

1. Wilson,K. & J.Walker. 2006. Principles & Techniques of Biochemistry & Molecular Biology. Sixth Edition Cambridge University Press.
2. Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean and Frank A. Settle, Jr.1986,Instrumental Methods of Analysis Seventh Edition. CBS Publishers and Distributors.

MBT 117 Cell Biology Lab & Instrumentation Lab

Cell Biology:

1. The Fractionation of rat liver.
2. Mitochondrial swelling.
3. The determination of lysosomal integrity.
4. Density gradient centrifugation for cellular fractionation.
5. TS of stem, root, leaf.
6. Microscopic observation of Animal cells.
7. Stages of Mitosis.
8. Stages of Meiosis.

Instrumentation Lab:

1. pH & buffer solutions.
2. Detection of pH using indicators.
3. Micrometry.
4. Titration of a mixture of a strong & weak acid.
5. Titration of a strong acid with a strong base.
6. Titration of a weak acid with a strong base.
7. Titration curves of amino acids
8. Paper Chromatography.
9. Thin layer Chromatography.
10. Separation of leaf pigments by adsorption chromatography.
11. Separation of amino acids by ion exchange chromatography.
12. SDS Gel Electrophoresis
13. Gas Chromatography.
14. The absorption curves of two dyes.
15. Demonstration of Beer's law.
16. The UV absorption of proteins & amino acids.

MBT 118 Microbiology Lab

1. Culture media preparation.
2. Aseptic techniques.
3. Media for preparation & storage of cultures.
4. Pure culture techniques.
5. Anaerobic culture.
6. Measurement of bacterial growth.
7. Staining methods.
 - Simple staining.
 - Negative staining.
 - Gram's staining.
 - Acid- Fast staining.
 - Endospore staining.
8. Determination of thermal death point.
9. Effect of UV on microorganisms.
10. Test for antibiotic sensitivity.
11. Isolation of bacteria from soil.
12. Isolation of cyanobacteria and morphological studies.
13. Mold study- Slide culture methods- Yeast characteristics.
14. Physiological Characteristics of Microorganisms.
 - Carbohydrate fermentation
 - TSI Agar test.
 - Methyl red test.
 - Acetoin production test.
 - Oxidative test.
 - Citrate utilization test.
 - Gelatin hydrolysis test.
 - Caesin hydrolysis test.
 - H₂S production test
 - Indole test
 - Aminoacid decarboxylase test.
 - Starch hydrolysis.
 - Catalase test.
 - Urease test.
 - ONPG test.
 - Nitrate reduction test.

MBT 119

Biochemistry Lab

1. Preparation of molar, normal & percent solutions.
2. Preparation of buffers(Ex. Phosphate, Borate)
3. Qualitative analysis of carbohydrates.
4. Tests to differentiate pentoses from hexoses.
5. Tests to differentiate reducing from non-reducing sugars.
6. Glucose estimation by DNSA & Glucose Oxidase methods.
7. Estimation of ethanol.
8. Protein estimation- Biuret & Lowry's methods.
9. Estimation of DNA & RNA in a mixture.
10. Determination of enzyme activity.
11. Effect of pH & temperature on Acid phosphatase enzyme.
12. Hydroxyl, acid & iodine values of lipids.
13. Precipitation of ammonium sulphate- salting out.
14. Paper chromatography- Amino acids & sugars.
15. Lipid profile- HDL,LDL,TG,VLDL.

MBT121

IMMUNOLOGY

UNIT : I.

Host – parasite relationship, normal microflora, infection – types, sources, routes of transmission. History of immunology, scope of immunology, haematopoiesis, cells and organs of the immune system, innate and acquired immunity. Immune responses – humoral and cell mediated.

UNIT : II.

Antigens, haptens, mitogens, adjuvants, immunoglobulins - structure and functions. Organization and expression of immunoglobulin genes, *in-vitro* and *in-vivo* antigen – antibody interactions, hybridoma technology.

UNIT: III.

Complements- components, activation pathways, functions. major histocompatibility complex. Antigen processing and presentation. Cytokines- structure and function. Cytokine receptors, biological functions of cytokines.

UNIT :IV

Hypersensitive reactions, Autoimmunity, Transplantation immunology, Tumor immunology, Immune deficiency diseases, AIDS, immunity to infectious agents, strategies of vaccine production.

UNIT:V.

Preparation of specimen for serology (serum, plasma, blood antigen), preparation of antigens from pathogenic bacteria, purification of antigen and antibodies, identification of blood cells, isolation of blood cells, Flow cytometry, nephelometry , FACS , isolation of macrophages and dendritic cells, culture of macrophages,immuno screening of recombinants,immunodiagnosis.

TEXT BOOKS:

- Richard A Goldsby, Thomas J Kindt, Barbara A Osborne and Janis Kuby (2003) Immunology 5th Edn. W.H.Freeman and Company
- Tizard IR (1995). *Immunology*, 4th Edn. Saunders College Publishing Harcourt Brace College Publishers.
- Roitt I, Brostoff J and Male D (1993). *Immunology* 3rd Edn, Mosby.

REFERENCES:

- Benjamini E, Coico R and Sunshine G (2000). *Immunology* 4th Edn, A John Wiley & Sons, Inc. Publication.
- Kuby J, Cameron J, Todd C, Mitchell J, *Immunology*, W.H. Freeman and Co., 2000

MBT 127 IMMUNOLOGY AND IMMUNOTECHNOLOGY LAB

- Identification of blood cells
- Differential count of white blood cells
- Preparation of specimen for immunology (serology)
- Preparation of blood antigens
- Blood grouping (ABO)
- Widal test
- Haemeagglutination
- Antistreptolysin- O (ASO) test
- Rheumatoid arthritis (RA) test
- C-reactive protein (CRP) test
- Pregnancy test
- Rapid plasma reagin (RPR) test
- Ouchterlony double immuno diffusion technique (ODD)
- Counter current immuno electrophoresis (CIE)
- Immuno electrophoresis (IE)
- Radial immuno diffusion (RID)
- Rocket immuno electrophoresis (RIE)
- Handling and restraining of laboratory animals
- Inoculation routes in laboratory animals
- Bleeding methods in laboratory
- Immunization in laboratory animals
- Serum electrophoresis by SDS – PAGE
- ELISA – HIV, HBsV
- Western blotting

MBT 122

MOLECULAR BIOLOGY & GENETIC

ENGINEERING

UNIT:I. DNA REPLICATION

Identification of DNA & RNA as genetic material-Hershey & Chase; Avery McLeod & McCarty, Bacterial conjugation, transduction & transformation.

DNA Replication-Models for DNA replication, mechanism & enzymology of DNA replication in pro-and eukaryotes.

UNIT:II TRANSCRIPTION AND TRANSLATION

Transcription-In prokaryotes & eukaryotes, features of promoters & enhancers, transcription factors, nuclear RNA splicing, ribozyme.

Translation- Genetic code, events of protein synthesis in pro-& eukaryotes.

UNIT:III CREATION OF RECOMBINANT MOLECULES

Restriction enzymes, designs of linkers&adaptors, Molecular vectors-prokaryotic & eukaryotic expression vectors.

UNIT:IV MOLECULAR TOOLS

Restriction mapping, Southern, western & northern blotting, DNA and Protein sequencing methods, mechanism & types of PCR,RFLP,RAPD,DNA finger & foot printing, DNA micro array, DNA and RNA shifting, site directed mutagenesis.

UNIT: V APPLICATIONS OF RECOMBINANT TECHNOLOGY

Gene transfer methods, cloning in plants, Ti plasmid, transgenic & knock out animals.

TEXT BOOKS:

1. David Friefelder, Molecular Biology, Narosa Publ,House,1999
2. Benjamin Lewin, Gene VII, Oxford University Press ,2000
3. Old RW, Primrose SB,'Principles of Gene Manipulation, An introduction to genetic engineering, Black well science Publication,1993.

REFERENCES:

1. Watson JD, Hopkins WH,Roberts JW,Molecular Biology of the gene,1987.

MBT 127 MOLECULAR BIOLOGY & GENETIC ENGINEERING LAB

- Agarose gel Electrophoresis
- Isolation of Bacterial DNA
- Preparation of Plasmid DNA
- Isolation of Plant DNA

- Isolation of Animal cell DNA
- Elution of DNA from Agarose gels
- Ligation of DNA
- Restriction enzyme digestion
- Transformation
- SDS – PAGE
- Western Blotting
- Plating and lysis of bacteriophages
- PCR.
- DNA sequencing demonstration.
- Scintillation counter.

MBT123

MICROBIAL TECHNOLOGY

UNIT:I.FERMENTATION EQUIPMENT AND IT USE

Screening-detection and assay of fermentation products-stock cultures-fermentation media-inoculum preparation-scale up of fermentation-increasing product yields-phage-dual or multiple fermentations-continuous fermentations and late nutrient additions-Biological waste treatment-patents and secret process-fermentation economics.

UNIT:II.TYPICAL FERMENTATION PROCESS

Antibiotic fermentation-penicillin-streptomycin-other antibiotics/ anaerobic fermentation-acetone-butanol fermentation-brewing-industrial alcohol- acetic acid/environmental control of metabolic pathways-glycerol from yeast-glycerol from bacillus subtilis/genetic control of metabolic pathways-indirect or dual fermentation-direct fermentation/ microbial oxidative transformation of substrate-vinegar-gluconic acid-steroid transformation/hydrocarbon fermentation/microbial cells as fermentation products-bakers yeast-food and food yeast-bacterial insecticides-legume inoculants-mushrooms-algae.

UNIT:III.VITAMINS AND GROWTH STIMULANTS

Vitamin B₁₂, Riboflavin, vitamin A, Gibberellins.

UNIT:IV.ENZYMES AND ORGANIC ACID FERMENTATION PRODUCTS

Amylases, Proteolytic enzymes, Pectinase, Invertase, other enzymes, Citric acid, Fumaric acid, Itaconic acid, Kojic acid, Bacterial gluconic acid and α -ketoglutaric acid fermentation.

UNIT:V.PROTEIN REFOLDING AND GENETIC STRATEGIES FOR DOWNSTREAM PROCESING.

Inclusion bodies, Denaturation and Renaturation: Expression vectors; Hyper-expression strategies: secretory vectors; Affinity tags

TEXT BOOKS:

- 1) L.E.Casida jr, Industrial Microbiology, Wiley eastern limited, New Delhi.
- 2) Verrall,M.S. and Hudson M.J. Separation for Biotechnology,ellis horwood ltd.,(1990)

REFERENCE:

- 1.Presscot,L.M, J.D.Hardley and D.A.Klein,1999.microbiology,WEBMc Graw hill

MBT124 BIOPROCESS PRINCIPLES AND TECHNOLOGY

UNIT: I.OVERVIEW OF FERMENTATION PROCESS

Overview of fermentation industry, general requirement of fermentation process, basic configuration of fermentor and ancillaries, main parameters to monitored and controlled in fermentation process.

UNIT:II.RAW MATERIALS FOR FERMENTATION PROCESS

Criteria for good medium, medium requirements for fermentation process, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements ,medium formulation of optimal growth and product formation, examples of complex and simple medium.

UNIT:III.METABOLIC STOICHIOMETRY AND ENERGITICS

Stoichiometry of cell growth and product formation, elemental balances, degree of reduction of substrate and biomass, available electron balances, yield co-efficient of biomass and product formation, maintenance co-efficient of energetic analysis of microbial growth and product formation.

UNIT:IV.KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION

Mode of operation-batch, fed batch and continuous cultivation. simple unstructured kinetic model for microbial growth monod model, growth of filamentous organism, product formation kinetics –leudeking piret model, substrate and product inhibition of cell growth and product formations

UNIT:V.BIOPROCESS ECONOMICS

Process economics, bio-product regulation, and general fermentation economics. Fine chemicals: enzymes, proteins via recombinant DNA, antibiotics, vitamins, alkaloids, nucleosides, steroids, monoclonal antibodies. Bulk oxygenates: brewing and wine making, fuel alcohol production, organic and amino acid manufacture, SCP, anaerobic methane production.

TEXT BOOKS:

- 1.Bailey and oilis, Biochemical engineering fundamentals, McGraw-Hill(2nd Ed),1986
- 2.Shule and Kargi, Bioprocess Engineering, prentice hall,1992

REFERENCES:

- 1.Pauline doran, Bioprocess Engineering calculation, Blackwell scientific publications.
- 2.Harveyw.blanch, Douglas S.clarck, Bioprocess Engineering, Marcel Dekker. Inc

MBT 129

BIOPROCESS TECHNOLOGY LAB

- Enzyme kinetics-michales menton parameters
- Enzyme activity-effect of temperature and p^H
- Enzyme Immobilization-Gel Entrapment
- Growth of bacteria-Estimation of biomass, calculation of specific growth rate.
- Growth of yeast- Estimation of biomass, calculation of specific growth rate.
- Cell disruption
- Production of enzyme-using batch Fermentor.

- Analysis of organic acids using gas chromatography
- Precipitation-ammonium sulphite precipitation.
- Production of citric acid by solid state fermentation.
- 11.Industrial visit report – Alcohol/Paper/Tannery industries

MBT125

BIOINFORMATICS

UNIT: I.COLLECTING AND STORING SEQUENCE DATA

Genomic Sequencing; Sequence assembly; Submission of Sequences; Sequence accuracy; Sequence databases; Sequence formats; Conversion between formats; Database browsers; EST databases; SNP databases; Annotation and Archival

UNIT:II.SEQUENCE ALIGNMENT AND APPLICATIONS:

Uses; Choice to be made for alignment; Scoring Matrices; Homology and related concepts; Dot matrix methods; Dynamic Programming methods for global and local alignments; Database searching – FASTA, BLAST; Statistical and biological significance

UNIT:III.MULTIPLE SEQUENCE ALIGNMENT AND APPLICATIONS:

Uses; Methods available- Iterative alignment, Progressive alignment – ClustalW, T-Coffee; Profile Methods – Gribskov profile, PSI-BLAST, HMM ; Clustering and Phylogeny; Methods for Phylogeny analysis: Distance and Character based methods;

UNIT:IV.PROTEIN STRUCTURE PREDICTION

Protein structure prediction – Primary, Secondary and Tertiary structure prediction methods and tools. Motif detection; Protein family databases

UNIT:V.DRUG DESIGN

Structure-based *De Novo* Ligand design, Quantitative Structure Activity Relationship QSAR, Combinatorial libraries, design of 'Drug like' libraries

TEXT BOOKS:

1. Current Protocols in Bioinformatics, Edited by A.D. Baxevanis et al, Wiley Publishers 2005
2. Bioinformatics by David W. Mount, Cold Spring Harbor Laboratory Press, 2001, ISBN 0-87969-608-7
3. Computational Molecular Biology by P. A. Pevzner, Prentice Hall of India Ltd, 2004 ISBN 81-203-2550-8
4. Fundamental concepts of Bioinformatics by D.E. Krane and M.L Raymer, Pearson Education 2003 ISBN 81-297-0044-1
5. Cynthia gibas, Per Jambeck 2001, Developing bioinformatics computer skills O'REILLY publication.

REFERENCES:

1. Kutti, C and *Unix programming: a conceptual perspective*, Tata McGraw Hill, 1995.
2. Gibas C, Jambeck P. *Developing bioinformatics in computer skills*. Oreilly & Associates Inc. Shroff Publishers, 2001.

(MBT126)Elective-1

BIOPHARMACEUTICAL TECHNOLOGY

UNIT: I. GENERAL PHARMACOLOGY

Introduction of pharmacology, sources of drugs, route of administration, mechanism of action of drugs. Pharmacogenetics and pharmacokinetics: absorption, distribution, metabolism and excretion of drugs.

UNIT: II.PHARMACOLOGICAL CLASSIFICATION OF DRUGS

a) Drugs acting on central nervous system

Analgesics, Antipyretics, Anti-inflammatory, Antidepressants and CNS stimulants.

b) Drug acting on cardio vascular system:

Anti-Hypertensive drugs and Anti-Hyper lipidemic drugs.

c) Drug acting on Urinary system:

Diuretics and Anti-diuretics

d) Drug acting on respiratory system:

Anti-Asthmatic drug

UNIT: III.PHARMACEUTICAL DOSAGE FORM

Compressed tablets-Wet granulation –Dry granulation or slugging-Direct compression-
Tablet presses, Formulation-coating-Capsules sustained dosage forms-Parental
solutions-Oral liquids-Injections-Ointments-Standard of Hygiene and Good
Manufacturing Practice.

UNIT: IV.NOVEL DRUG DELIVERY SYSTEM

Transdermal delivery system, liposomes and Nanoparticles.

UNIT:V.BIOPHARMACEUTICAL

Various categories of therapeutics like vitamins, antibiotics, hormones and biologicals

TEXT BOOKS:

1.Medical pharmacology , K.D.Tripathi

2.Katzung , B.G.Basis and clinical pharmacology, prentice hall of international

3.Pharmacology and therapeutics-Satoskar

REFERENCE:

1..Pharmaceutical dosage forms:tablets volume-3 by liberman and lachman.

2.Theory and practice of industrial pharmacy by lachman.

3.Novel drug delivery system –y,w.chen

ELECTIVE-2

CANCER BIOLOGY

UNIT:IFUNDAMENTALS OF CANCER BIOLOGY

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumor suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer.

UNIT:II.PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT:III.PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases.

UNIT:IV.PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinase and tumor cell invasion.

UNIT:V.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.

TEXT BOOKS:

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

REFERENCE.

1. "An Introduction Top Cellular And Molecular Biology of Cancer", j Oxford Medical Publications, 1991.

MBT 231 - ENZYME ENGINEERING AND TECHNOLOGY

UNIT I: INTRODUCTION TO ENZYMES

Classification and Nomenclature of enzymes according to IUB. Mechanisms of enzyme action; concept of active site and energetic of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis-collision theory, transition state theory; role of entropy in catalysis.

UNIT II: KINETICS OF ENZYME ACTION

Order of reaction, Activation energy, Kinetics of single substrate reactions; estimation of Michelis-Menten parameters, multisubstrate reactions-mechanisms and kinetics; turn over number; types of inhibition and models-substrate, product. Allosteric regulation of enzymes, Monod changeux wyman model, pH and temperature effect on enzymes and deactivation kinetics.

UNIT III: ENZYME INHIBITORS AND IMMOBILIZATION

Enzyme Inhibitor – Kinetics of competitive, non-competitive and uncompetitive inhibitors. Allosteric interaction mechanism of enzyme catalysis, electrostatic proximity and orientation effect

Enzyme Immobilization - Physical and chemical techniques for enzyme immobilization-adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

UNIT IV: PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES - Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterizations of enzymes; development of enzymatic assays.

UNIT V: APPLICATION OF ENZYME TECHNOLOGY - Enzyme Biosensor in analysis; design of enzyme electrodes and their application as biosensors in industry. Structure and function of Co-enzyme – reaction involving TPP, Pyridoxal phosphate, Nicotinamide, Flavin Nucleotides, Co-A, Biotin and Vitamin K dependent carboxylation. Enzyme application in health care and environment.

TEXT BOOKS

1. Harvey W.Blanch, Douglas S.Clark, “Biochemical Engineering”, Marcel Dekker, Inc.
2. James M.Lee, “Biochemical Engineering”, PHI, USA.

REFERENCES

1. James. E.Bailey and David F.Ollis, “Biochemical Engineering Fundamentals”,McGraw-Hill.
2. Wiseman, “Enzyme Biotechnology”, Ellis Horwo

MBT 232 - DOWNSTREAM PROCESSING

UNIT I : ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Economics of downstream processing in Biotechnology, cost-cutting strategies, characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products, and low volume, high value products), physicochemical basis of bioseparation processes.

UNIT II: PRIMARY SEPERATION AND RECOVERY PROCESSES

Cell distribution methods for intracellular products, removal of insoluble, biomass (and particulate debris) separation techniques, flocculation, sedimentation, centrifugation and filtration

UNIT: III ENRICHMENT OPERATION PRODUCT RESOLUTION/FRACTIONATION PRODUCT POLISHING

Membrane based separations (micro and ultrafiltration theory, design and configuration of membrane separation equipment, applications, and precipitation methods with salts and organic solvents, and polymers, extractive separations, aqueous two phase extraction, supercritical extraction) insitu product removal, integrated bioprocessing.

UNIT: IV PRODUCT RESOLUTION/FRACTIONATION

Adsorptive chromatographic separation processes, electrophoretic (all electrophoresis techniques including capillary electrophoresis) hybrid separation technologies (membrane chromatography, electro chromatography, Affinity chromatography, etc..)

UNIT V: FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS

Crystallization, Gel Permeation Chromatography, Dialysis, Drying and Lyophilization in final product formulation.

TEXT BOOKS

1. P.A. Belter, E.L. Cussler and Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pub. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology By Open Learning Series, Butterworth-Heinemann (1992).

REFERENCES

1. J.C. Janson and L. Ryden, (Ed.) – Protein Purification – Principles, High Resolution Methods and Applications, VCH Pub. 1989.
2. R.K. Scopes – Protein Purification – Principles and Practice, Narosa Pub. (1994)

MBT 233 - PLANT BIOTECHNOLOGY

UNIT I: PLANT GENOME ORGANISATION - Plant genome- structure of Plant cell & cell organelles, nucleosome structure and its biological function, junk & repeat sequence. Chloroplast DNA and Mitochondrial DNA, Cytoplasmic male sterility

UNIT II: BASICS OF PLANT TISSUE CULTURE - Tissue culture-media, plant hormones and growth parameters, embryogenesis, organogenesis. Meristem, anther, microspore culture. Embryo and ovary culture. Protoplast fusion - Somatic hybrids, cybrids, somaclones, somaclonal variations.

UNIT III: METHODS IN PLANT BIOTECHNOLOGY - Genetic transformation methods and production of transgenic plants - Ti and Ri plasmids. Gene transfer techniques, Agrobacterium -mediated transformation, viral vectors, Gene Knock out and gene silencing

UNIT IV: MOLECULAR PLANT PHYSIOLOGY

Molecular basis of pathogenesis, rubisco synthesis and its significance. molecular basis for sexual incompatibility in plants. - Metabolic Engineering and Industrial Products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway; alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology. Phytoremediation. Plant host-insect interactions. *nif* and *nod* genes.

UNIT V: APPLICATION OF PLANT BIOTECHNOLOGY

Herbicide resistance - phosphinothricin, glyphosate, sulfonyl urea and atrazine. Insect resistance – *Bt* genes, non-*Bt* genes like protease inhibitors, alpha amylase inhibitor. Disease resistance - chitinase, 1,3-beta glucanase, RIP, antifungal proteins, thionins, PR proteins; Virus resistance: coat protein mediated, nucleocapsid gene. Nematode resistance. Abiotic stress - Drought, cold and salt. Post-harvest losses: long

shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase, RNAi and Reverse genetics.

TEXT BOOKS

1. Gamburg OL., Philips GC. Plant tissue & Organ culture fundamental methods, Narosa publications. 1995
2. Adian Slater, Nigel Scott & Mark Flower, Plant Biotechnology, The genetic manipulation of plants, Oxford University Press, 2003
3. Singh BD. Text book of Biotechnology, Kalyani publishers 1998

MBT 234 - ANIMAL BIOTECHNOLOGY

UNIT I: INTRODUCTION - Structure and organization of Animal cells - Culture media; Balanced salt solutions and simple growth medium, Physical, chemical and metabolic functions of different constituents of culture medium; Role of carbon dioxide, serum, growth factors, glutamine in cell culture; Serum and protein free defined media and their applications.

UNIT II : CELL CULTURE TYPES AND MEDIA - Types of cell culture: primary and established culture; organ culture; tissue culture; three dimensional culture and tissue engineering; feeder layers; disaggregation of tissue and primary cell culture; cell separation; cell synchronization; cryopreservation. - Biology and characterization of cultured cells: tissue typing; cell-cell interaction; measuring parameters of growth; measurement of cell death; Apoptosis and its determination; Cytotoxicity assays – application of animal cell culture - Engineered cell culture as source of valuable products and protein production

UNIT III: MOLECULAR BASIS OF CELL CULTURE - Molecular techniques in cell culture: cell transformation; physical, chemical and biological methods; Viral gene delivery systems: Adenoviruses, ALVs, Baculoviruses; manipulation of genes; cell cloning and micro manipulation; IVF, hybridoma technology and its applications; cell fusion methods; gene mapping; vaccine production; gene therapy, targeting, silencing and knockout. Selectable markers like pSV and pRSV plasmids - reporter genes.

UNIT IV: EMBRYOLOGY AND FERTILISATION - Embryology: Collection and preservation of embryos; culturing of embryos; Gametogenesis and fertilization in animals; types of cleavage pattern; role of maternal contributions in early embryonic development; genetic regulation of embryonic development in Drosophila; homeotic genes in development; stem cell culture, embryonic stem cell and their applications.

UNIT V: APPLICATION OF ANIMAL TISSUE CULTURE - Transgenics: Transgenic animal: production and application; transgenic animals as models for human diseases; transgenic animals in live-stock improvement; expression of the bovine growth hormone; transgenics in industry; chimera production; Ethical issues in animal biotechnology.

References

1. Animal cell culture; A practical approach, 4th Edition, by Freshney. R.I. John Wiley publication.
2. Methods in cell biology; Volume 57, Animal cell culture methods, Ed. Jennie P. Mather, David Barnes, Academic press.
3. Mammalian cell biotechnology; A practical approach, Ed. M. Butler, Oxford university press.
4. Exploring genetic mechanism; Ed. Maxine Singer and Paul Berg.

5. Principles of genetic manipulation; Ed. Old and Primrose, 6th Edition. Blackwell science publication.

MBT 235 - HUMAN VALUES, PROFESSIONAL ETHICS AND IPR

UNIT I: HUMAN VALUES

Morals, values and Ethics - Integrity - work ethic - Service Learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self Confidence - Character - Spirituality

UNIT II: PROFESSIONAL ETHICS

Sense of Professional Ethics - Variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan theory - consensus and controversy - Models of professional roles - theories about right action - Self-interest - Customs and religion - uses of ethical theories.

UNIT III: SAFETY RESPONSIBILITIES AND RIGHTS

Introduction to intellectual property and intellectual property rights – types: patents, copy rights, trade marks, design rights, geographical indications – importance of IPR – patentable and non patentable – patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO)

UNIT IV: GLOBAL ISSUES

Multinational Corporations - Environmental Ethics - Computer Ethics - Bioweapon development - Witness and advisors - Moral Leadership - Sample Code and Conduct.

UNIT V: BIOTECHNOLOGY AND RISK

Ethical implications of cloning: Reproductive cloning , therapeutic cloning ; Ethical, legal and socio-economic aspects of gene therapy, germ line, somatic, embryonic and adult stem cell research- GM crops and GMO's – biotechnology and biopiracy – ELSI of human genome project

TEXT BOOKS

1. Professional Ethics and Human Values - M.P.Raghavan- SciTech Publications 2006
2. Professional Ethics - V.Jeyakumar
3. Biotechnology And Safety Assessment (II) John A.Thomas
4. <http://books.cambridge.org/0521384737.htm>
5. <http://online.sfsu.edu/%7Erone/GEessays/gedanger.htm>
6. http://www.actahort.org/members/showpdf?booknrarnr=447_125
7. <http://www.cordis.lu/elsa/src/about.htm>
8. <http://www.biomedcentral.com/content/pdf/1472-6939-2-2.pdf>
9. http://lifesciences.cornell.edu/vision/accelerating_focus05.php
10. <http://thompson.com/libraries/fooddrug/>

11. <http://assets.cambridge.org/0521792495/sample/0521792495WS.PDF>
12. http://europa.eu.int/eurlex/pri/en/oj/dat/1998/I_213/I_21319980730en00130021.pdf
13. <http://www.clubofamsterdam.com/content.asp?contentid=281>

MBT 236 - ENVIRONMENTAL BIOTECHNOLOGY

UNIT I: BASIC CONCEPTS - Interactions between environment and biota; Concept of habitat and ecological niches; Limiting factor; Energy flow, food chain, food web and trophic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature. Concepts and theories of evolution - Population ecology - community structure.

UNIT II: ECOSYSTEM DYNAMICS AND MANAGEMENT - Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development. Global environmental problems: ozone depletion, UV-B green house effect and acid rain, their impact in biotechnological approaches for management.

UNIT III - ENVIRONMENTAL POLLUTION - **Types** of pollution, Methods for the measurement of pollution; Methodology of environmental management – the problem solving approach, its limitations. Air pollution and its control through Biotechnology. Water Pollution and control: Need for water management, Measurement and sources water pollution. Kind of aquatic habitats, (fresh and marine), distribution and impact of environmental factors on the aquatic biota, productivity, mineral cycles and biodegradation different aquatic ecosystems.

UNIT – IV - WASTE WATER TREATMENT - Waste water collection, Physico-chemical properties of water, physical, chemical and biological treatment processes. Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries.

Management of estuarine, coastal water systems and man-made reservoirs; Biology and ecology of reservoirs.

UNIT – V – XENOBIOTICS - Ecological considerations, decay behavior and degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wastelands. Solid waste: Sources and management (composting, vermiculture and methane production). Environmental mutagenesis and toxicity testing.

References

1. Environmental Biotechnology by Alan Scragg. Pearson Education Limited, England.

2. Environmental biotechnology by S.N. Jogdand. Himalaya Publishing House. Bombay.
3. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi
4. Environmental chemistry by A.K. De Wiley Eastern Ltd. New Delhi.
5. Introduction to Biodeterioration by D. Allsopp and k.J. Seal, ELBS/Edward Arnold.

MBT 237 - ENZYME ENGINEERING LAB

1. Demonstration of Bioreactors
2. Preparation of Buffers & Standards
3. Microbial Growth Kinetics
4. Isolation of alkaline phosphatase from potato
5. Isolation of amylase from *Aspergillus* Spp.,
6. Isolation of citrase
7. Identification of pKa value
8. Michelis-Menten - kinetics of enzyme
9. Bioassay of Enzyme (amylase, protease, citrase)
10. Preparation of Buffers & Standards

MBT 238 - PLANT BIOTECHNOLOGY & ANIMAL BIOTECHNOLOGY LAB

PLANT BIOTECHNOLOGY LAB

1. Callus Induction
2. Production of Callus and Suspension Culture
3. Micropropagation
4. Anther and pollen Culture
5. Plant DNA isolation
6. Plant RNA isolation
7. Plant Protoplast Isolation
8. Preparation of Synthetic seeds
9. Embryo Culture
10. Hardening of in-vitro plant

ANIMAL BIOTECHNOLOGY

1. Media preparation
2. Primary cell culture
3. Cell viability test
4. Cell Counting by heamocytometre
5. Animal DNA isolation

MBT 239 - DOWN STREAM PROCESSING LAB

1. Solid liquid separation – centrifugation, microfiltration
2. Cell disruption techniques – ultrasonication, 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

MBT241 RESEARCH METHODOLOGY & BIostatISTICS

1. STATISTICAL METHODS

Collection of data – type of distribution, significance tests, Students t-test, Analysis of variance, correlation and regression, chi-square test.

2. BASICS OF COMPUTER

Input and output devices, CPU, machine and assembly language, compiler, assembler and interpreter, Flow charts, Software's used in statistics and graphics

3. MICROSCOPY

Principles and applications; Light microscope, Phase contrast microscope, Fluorescent microscope, Scanning electron microscope (SEM), Transmission electron microscope (TEM), Fixation and staining and Histochemical studies.

4. ANALYTICAL TECHNIQUES

Differential centrifugation – Density gradient and ultra centrifugation, Chromatography – principles and application – TLC, GC, HPLC, Affinity and sieve chromatography, Electrophoresis – Agarose gel, SDS-PAGE electrophoresis, Blotting Techniques, Isoelectric focusing, Beer-Lambert's Law – UV-VIS, Spectrophotometer- Principles and application of Fluorimeter, AAS, Infrared spectrometer, NMR, PCR, RFLP, RAPD analysis, DNA finger printing, Micro array technique.

5. IMMUNOTECHNOLOGY

Antigen antibody interaction, Isolation of pure antibodies, Isolation of Lymphocytes and sub-populations, Immunofluorescence, Immunoblotting RIA, ELISA,, Chimeric antibodies, Monoclonal Antibodies – Synthesis and applications.

References:

1. Gurumani.N “Research methodology for Biological Sciences” Mjp Publishers, 2006
2. Keith Wilson, John Walker “Practical Biochemistry” Cambridge, University Press Fourth Edition.
3. Hobarth Willard, Lynne Merritt “Instrumental Methods of Analysis” C.B.S Publishers and Distributors, 1992.
4. Sewell P.A., Clarke B., “Chromatographic Separation”, John Wiley & Sons, 1991.
5. Balagurusamy.E, “Computing fundamentals & C Programming” Tata McGraw Hill, 2008.
6. Veerarajan.T, “Probability, Statistics & Random Process”Tata McGraw Hill, Second Edition.

Elective 3:

DRUG DESIGNING

Unit – I: Drug Discovery

Drug discovery: Overview of the drug discovery process,, Modern methods of drug discovery, Various phases- Drug discovery pipeline, Economics of drug discover, Stages and strategies of drug discovery, Rational approach in Drug design, Computer aided drug design, Classification of Drugs, Routes of Drug Administration, Drug ADMET. Drug Receptor interactions.

Unit – II: Receptor Concepts

Molecular targets and pathways relevant to disease processes; Receptors, channels, transporters and enzymes as drug targets; Role of protein 3D structures in the drug discovery process, Techniques for protein structure prediction- Comparative modeling.

Unit –III: Molecular Structure Generation

Coordinate systems, Molecular graphics, Structure Visualization-PDB Format, Small Molecule Structure Database, Molecular Geometry, Energy Calculations Structure Generation and Manipulation strategies, Tools for Structure generation.

Unit - IV: Molecular Dynamics

Introduction, Molecular Dynamics using simple models. Dynamics with continuous potentials. Constant temperature and constant dynamics. Conformation searching, Systematic search, Random Search, Conformational Analysis using Monte-carlo and Molecular dynamics.

Unit - V: Molecular Modeling to Discover and Design New Molecules

3D pharmacophores, molecular docking and their algorithms, De novo Ligand design, 3D data base searching and virtual screening, QSAR IP issues in drug design-process & product patents, drug licensing, clinical trials data management.

TEXTBOOKS

1. *Molecular Modeling, Principles & Applications, Andrew R.Leach.*
2. *Molecular Modeling by Hans Dieter, Heltje & Gerd Folkens, VCH.*

3. *Essentials of Drug Designing* by V.Kothekar, Dhruv Publications.
4. *'Modern Methods of Drug Discovery'* by Gerhard Edwin Seibold, Alexander Hillisch, Rolf Hilgenfeld Publisher.

REFERENCES:

1. *Chemical Applications of Molecular Modelling* by Jonathan Goodman.
2. "Drug Design: Cutting Edge Approaches". *Angewandte Chemie, International Edition*, Vol.42,
3. "Biopharmaceutical Drug Design and Development". Susanna Wu-Pong and Yongyut Rojanasakul,
4. "Advanced Drug Design and Development" Kourounakis Taylor and Francis.

Elective 3

METABOLIC ENGINEERING

INTRODUCTION: Jacob Monod model, catabolite regulation, glucose effect, cAMP deficiency, feed back regulation, regulation in branched pathways, differential regulation by isoenzymes, concerted feedback regulation. Cumulative feedback regulation, amino acid regulation of RNA synthesis, energy charge, regulation, permeability control

METABOLIC FLUX BALANCE ANALYSIS: Under determined, Determined, Overdetermined system, Experimental methods –using ^{13}C isotopes.

METABOLIC ENGINEERING OF *E.COLI*: Engineering of central metabolism, Engineering for production of aromatic compounds, Amino acid production, Antibiotic production

METABOLIC ENGINEERING OF *CLOSTRIDIUM* AND YEAST: Solvent production by *C. acetobutylicum*, metabolic engineering in yeast for substrate utilization and metabolite production, engineering heterologous secretion

METABOLIC ENGINEERING OF PLANT, MAMMALIAN CELLS: Metabolic engineering for production of plant secondary metabolites, metabolic engineering of mammalian cells –engineering of cell cycle and apoptosis, Glycosylation

BIOREMEDIATION , BIOMASS UTILISATION AND GROWTH PROMOTION: Microbial degradation of xenobiotics, Genetic engineering of biodegradative pathways, Cellulose degradation , nitrogen fixation

TEXTBOOKS

1. Stanbury PF and Whittaker A., Principles of Fermentation Technology, Pergamon Press., Oxford, 1984
2. Glick and Pasternak, 'Molecular Biotechnology', ASM Press, Washington D.C, 1994
3. Sang Yup Lee & Papoutsakis, " Metabolic Engineering" Marcel Dekker, Inc. New York, 1999

REFERENCES:

1. Wang.DIC., Cooney C.L., Demain A.L. Dunnill .P., Humphrey AE., Lilly M.D., Fermentation and Enzyme Technology, John Wiley & Sons., New York,. 1980
2. Zubay G., Biochemistry -2nd Edition, Macmillan Publishing Company, NY, 1989

INTRODUCTION TO DEVELOPMENTAL BIOLOGY: Development among unicellular eukaryotes. Development pattern among the metazoans. Differential cell affinity.

PATTERNS OF DEVELOPMENT: Fertilization, Cleavage, Gastrulation, Neurulation and the ectoderm. Axonal specificity, Mesoderm & endoderm

MECHANISM OF CELLULAR DIFFERENTIATION: Transcription factors –activation of specific promoters, chromatin. Control of development by differential RNA processing and translation

SPECIFICATION OF CELL FATE AND THE EMBRYONIC AXES: Autonomous cell specification by cytoplasmic determinants, Genetics of axis specification in Drosophila, Specificity of cell fate by progressive cell-cell interactions, Establishment of body axes in mammals and birds

CELLULAR INTERACTION DURING ORGAN FORMATION: Proximate tissue interaction, Development of the tetrapod limb. Cell interaction at a distance: Hormones as mediators of development. Sex determination. Environmental regulation of animal development. Saga of germ line. Developmental mechanisms of evolutionary change

TEXTBOOK:

1. Slack, JMW, Essential Developmental Biology, Blackwell Scientific Publications, New York, 2001.

REFERENCE

1. Wolpert. L, “Principles of Development”, Oxford University Press, Oxford, 1998.