

Unit 3 Proteins and Vitamins 9

Amino acids – Classification, and Properties, Proteins – Structure - Primary Structure, Secondary Structure, Tertiary Structure, Vitamins – Structure, biological functions and biosynthesis, Fat Soluble Vitamins- A & D, Water soluble vitamins B & C

Unit 4 Metabolism 10

Overview of carbohydrate, protein and fat metabolism. Glycolysis, Krebs Tricarboxylic acid cycle, glycogenesis, Glycogenolysis, gluconeogenesis, Photosynthesis: Light reactions - Hill reaction, cyclic and non-cyclic photophosphorylation, Dark reactions – Calvin cycle, Control of Calvin cycle. Starch biosynthesis and degradation Biosynthesis of non-essential amino acids, Catabolism of proteins-Oxidative and Non-Oxidative deamination, Transamination, Decarboxylation, Biosynthesis of long chain fatty acids, β -oxidation of Fatty acids. Biosynthesis and degradation of purine and pyrimidine Nucleotides and nucleic acids Inter relationship between carbohydrate, fat and protein metabolism.

Unit 5 Biological Oxidation 10

Biological Oxidation: High energy phosphates. Components of Electron transport chain and the sequence of electron transport, Oxidative phosphorylation. The chemiosmotic theory, Mechanism of ATP synthesis

Total 45

Text Book

1. Biochemistry-Voet D. and Voet G., Second Edition, John Wile and Sons, 1994.

Reference Books

1. Biochemistry — Zubay Zubay. G, "Biochemistry", Second Edition, Maxwell Macmillan Intern
2. ational Editors, 1987.
3. Lehninger A.L., Nelson D.L., Cox .M.M, "Principles of Biochemistry", CBS Publications, 1993.
4. Stryer L. "Biochemistry", Fourth Edition, W.H. Freeman & Company, New York, 1999.
5. Harper's Biochemistry-Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W.
6. Conn, E and P.K. Stump, "Outlines of Biochemistry", Willey Eastern Ltd., New Delhi, 1984.
7. Albert, L. Lehninger et al, "Biochemistry", 5th edition, Work Publishing, 2000.

CELL BIOLOGY & MICROBIOLOGY

L T P C

3 0 0 3

Unit 1 Structure of cell membrane, Cytoskeleton 7

Plasma membrane – Composition and structure, Membrane associated Receptors, Artificial membranes (liposomes) – Membrane proteins and Principles of membrane organization – Cell junction. Cytoskeleton: Topography, microtubules, microfilaments, lattice and cytosol –Microtubules and cell mobility – cilia and flagella.

Unit 2 Cell cycle & cell differentiation 10

Cell division and cell cycle: G0-G1 transition Chromosome movements Regulation of cell division Cell differentiation: Cortical differentiation, Nuclear differentiation, differentiation of erythrocytes. Difference between Normal and cancer cells.

Unit 3 Introduction of Microbiology 8

Definition and historical account of microbiology. Diversified microbial World-Classification of microbes based on whittaker's five kingdom System of classification. Structures of Bacteria, Viruses, Fungi, and algae

Unit 4 Techniques 10

Nutritional requirements and growth cycles of the above mentioned Groups. Media for growth: Types, Preparation, methods of sterilization. Isolation and enumeration of microorganisms in soil, water and air. Isolation of microorganisms from contaminated food. Techniques of Pure culture, maintenance and preservation; Staining: stains and dyes, Types of staining; General techniques involved in Virology and Protozoology.

Factors influencing the growth of microbes-classification based on that. (Temperature, pH, Nutrition). Symbiotic associations, commonsals; Saprophytes, etc. Microbiology of fermented foods-dairy products, Meat and fish, alcoholic beverages-beer, wine etc. Food spoilage and Preservation processes. Microbes as source of food. Application of Microbes in industries production of antibiotics, amino acids organic Acids, bioconversion process, microbial insecticides.

Total 45

Text Books

1. Molecular and Cell Biology, Darnell, James, Harvey Lodish and David Baltimore, Scientific America Books. Distributed By W.H. Freeman and Co. Newyork, 1998.
2. Molecular Biology of the gene – Watson, Baker et al., Pearson education, 5th Edition.
3. Pelczar M.J., Chan ECS and Krieg NR, "Microbiology", Tata McGraw Hills Edition, New Delhi, India.
4. Prescott, Harley and Klein, 'Microbiology", McGraw Hill publications, Fifth edition 2003.

Reference Books

1. Molecular Cell Biology, Media Connected, Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D. and Darnell, J. W.H. Freeman and Company 2000.
2. Molecular and Cellular Biology, Wolfe, Stephan L. Wadsworth, Inc. California, USA, 1999.
3. Cell and Molecular Biology – Concepts and Experiments, Gerald Karp and Nancy L. Puritt, John Wiley and Sons, Inc., 1998.

4. Cell and Molecular Biology, De Robertis, E.D.P., and De Robertis, E.M.F., (6th Ed.) W.B. Saunder College, Philadelphia, 1990.
5. Gene 7-Benjamin Lewin, Oxford University Press.
6. Genomes – T.A. Brown, Latest edition, John Wiley & Sons.
7. Fundamental principles of Bacteriology – A.J. Salle
8. Microbiology – Michael J. Pelchar, E.C.S, Chan Noel R. Krieg.
9. Microbial physiology – Albert G. Moat and John W. Foster- Wiley- interscience publication
10. Food microbiology-W.C. Frazier and D.C. Westhoft, tata Mcgra Hill Publication.
11. Microbial Biotechnology – Alexander N. Glazer, Hiroshni – Kaido, W.H. Freeman and Co. 1995.
12. Chemical Microbiology, Antony H. Rose, Butterworths, Third Edition, plenum Press, 1976.
13. Principles of fermentation technology, P.F. Stanbury, A. Whitaker, S.J. Hall, Second Edition, Pergamon Publishers, 1995
14. Biotechnology, A text of "Industrial Microbiology, Wulf Crueger and Anneliese Crueger, Second Edition, Sinauer Associates Inc, Sanderland, 1989c.

BIOLOGICAL TECHNIQUES AND INSTRUMENTATION

L T P C

3 0 0 3

Unit I Chromatography and Electrophoretic techniques 10

Chromatography – Principle, operative technique and applications Of paper, TLC, adsorption chromatography, GLC, and HPLC. Ion-Exchange, molecular sieve Electrophoretic techniques – Principle and technique of gel, SDS, high voltage and Discontinuous electrophoresis, Isoelectric focusing. Pulsed field

Get electrophoresis and capillary electrophoresis.

Unit II Spectrophotometry 9

Basic principles, Instrumentation and applications of UV, Visible IR spectrophotometers and Mass Spectrometry. Flame Photometry

- Principles and applications.

Unit III Centrifugation techniques 8

Principle, methodology and application of analytical centrifugation, Differential centrifugation, density gradient centrifugation, Ultra – Centrifuge.

Unit IV X-Rays 9

X-Ray diffraction, crystals and detectors, quantitative analysis and Applications. Radio chemical methods – Basic concepts, counting

Methods and applications. Autoradiography.

Unit V **Tracer and other techniques** **9**

Tracer and other techniques – radioactive decay, units of radioactivity

Detection and measurement of radio activity, Geiger – Muller counter

Scintillation counter. Applications of radioisotopes in biology.

Total 45

References:

1. An introduction to practical biochemistry by David T. Plummer.
2. Laboratory Manual in biochemistry by Pattabiraman and Acharya.
3. Practical biochemistry by J. Jayaraman.
4. Analytical Biochemistry, D.J.Homie and Hazal Peck, Longman group 3 rd edition, 1998.
5. Physical Biochemistry – Application of Biochemistry and Molecular Biology, David Friefelder, W.H.Freeman and Co., Second Edition, 1999.
5. Experimental Biochemistry, Robert Switzer and Liamgarrity, W.H.Freeman And Co., Third Edition, 1999.

BIOSTATISTICS

L T P C

3 1 0 4

Unit 1 Introduction

7

Data – Classification & Tabulation, Diagrammatic & Graphical Display, Measures of Central Tendency – Mean, Median, Mode, Quartiles, Measures of Dispersion – Range, Mean Deviation, S.D. Variance, Quartile Deviation, Measures of Skewness and kurtosis.

Unit 2 Probability theory and distributions

12

Probability, Basic Definitions, Events, Complements, Unions and Intersections, Probabilities of events, Addition and Multiplication Rule Conditional probability, Independence of Events, Bayes theorem Applications of Principles of Probability to Biological Problems. Theoretical Probability Distributions: Binomial, Poisson, Normal

Unit 3 Correlation and Regression Analysis

9

Types, Methods, Scatter Diagram, Two-way frequency table, Karl Pearson's method, Spearman's Rank method Regression equations, Methods – Scatter Diagram, Mathematically By the method of least squares

Unit 4 Sampling & Testing of hypothesis

7

Sampling, Sampling theory, Sampling distribution, sampling error, Central limit theorem, sampling theory of correlation, sampling Theory of regression, Null & Alternate hypothesis, Sampling of Variables, Sampling of attributed, Two tailed and one tailed tests Estimation: Point, Interval

T – test – Applications: Estimation of population Mean, Matched Pair Data Analysis, Comparison of Means of Two Groups. Chi square test – Applications: Test of Goodness of Fit, Test of Independence, Test of Homogeneity. ANOVA – Applications: One-way Classification Design, Two-way Classification Design, Randomized Block Design.

Total 45

Text Books

1. An Introduction to Biostatistics – N. Gurumani, 2004, MJP Phblishers
2. Fundamentals of Biostatistics – Khan and Khanum. 2004, Ukaaz Publications

Reference Books:

1. Biostatistical Analysis (4th Edition) by Jerrold H. Zar
2. Fundamentals of Mathematical Statistics – S.C. Gupta & V.K. Kapoor
3. Fundamentals of Biostatistics by Bernard Rosner
4. Intuitive Biostatistics by Harvey Motulsky
5. Satisfistics for Biologists – Campbell. R.C.
6. Biostatistics, A Foundation for Analysis in Health Sciences- Wayne W. Daniel, Seventh edition, John Wiley & Sons, 2000.
7. Statistical methods in Bioinformatics – W. Ewans & G. Grant.

BIOPHYSICS

L T P C

3 0 0 3

Unit 1 Laws of Physics

9

Introduction, Quantum Mechanics- Max-Planck theory, Einstein's Equation. De Broglie's equation, Schrödinger wave function, Heisenberg Uncertainty principle, Electronic structure of atoms, quantum numbers, Pauli's exclusion principle, Molecular orbital-Bonding and anti-bonding, Covalent bond, ionic bond, Vander walls interaction, Hydrogen bonding Radioactivity - radioactivity, rate of radioactive decay, effects of Radioactivity on matter, biological effects of radiation, and applications Of radioisotopes.

Unit 2 Solids and Fluids

8

Thermodynamics - Entropy, Enthalpy, Free energy of a system, First law of thermodynamics, Second law of thermodynamics Properties of Solids, stress and strain in solids, Hook's law, stress-strain curves, Properties of fluids, Viscosity, Viscoelastic materials, Osmosis, Fundamentals of rheology.

Unit 3 Physio-chemical techniques to study Biomolecules 10

Introduction, Hydration of macromolecules, Role of friction, Diffusion Sedimentation, Ultracentrifuge, Rotational diffusion, Light scattering, Small angle X-ray scattering, Tunneling Electron Microscopy, Atomic Force Microscopy, Principle of X - ray Crystallography, Principle of NMR Spectroscopy.

Unit 4 Structure and Dynamics of biomolecules

10

Introduction, Nucleic acid structure, chemical structure, conformational

Possibilities of monomers and polymers, Polymorphism, of DNA, Unusual DNA structures, Protein structure, Protein-substrate interactions, Virus structure and physical properties.

Unit 5

Biological Transport Mechanisms

8

Physical and chemical properties of Biomembranes, Dynamics of basicPhysiochemical properties in signal transduction. Flow of fluids, Stokes Law, Hagen-Poiseuill's law, Reynolds number, Physics of membrane Potential, voltage clamping.

Total 45

Text Books

1. Biophysics, Vasantha Pattabhi and N. Gautham, Narosa Publishing house, 2002.

Reference Books

1. Methods in Modern Biophysics by Bengt Nolting
2. Biophysics: An Introduction by Rodney M. J. Cotterill
3. Biological Thermodynamics by Dobald T. Haynie
4. Molecular Biophysics: Structures in Motion by Michel Daune, et al
5. Biophysics by Roland Glaser.
6. Essentials of Biophysics by Narayanan

PRACTICAL : BIOCHEMISTRY AND BIOMOLECULES

L T P C

0 0 4 2

1. Qualitative analysis of carbohydrates – Glucose, fructose, galactose, maltose, lactose, sucrose.
2. Qualitative analysis of amino acids – Tyrosine, tryptophan, phenylalanine, Methionine, serine, histidine, proline.
3. Estimation of glucose- Benedict's method.
4. Estimation of ascorbic acid.
5. Estimation of acid number of oil.
6. Estimation of glycine by Sorenson's formal titration.
7. Estimation of calcium.
8. Estimation of urea – DAM method.
9. Estimation of protein by Lowry's method.
10. Separation of amino acids by paper chromatography

PRACTICAL: MICROBIOLOGY

L T P C

0 0 4 2

1. Preparation of media for growth of various organisms.
2. Identification and culturing of various organisms
3. Staining and enumeration of microorganisms.
4. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
5. Assay of antibiotics production and demonstration of antibiotic resistance.
6. Bacterial transformation and transduction.
7. Culturing of phages and assaying of plaques (Titration of Phage T4)
8. Use of antimicrobial chemotherapeutic agents to control microorganisms.
9. Diagnostic tests to identify various organisms.
CO₂ fixation by photosynthetic microbes.

Histones – Association of histones to the DNA (Nucleosomes) –
Position of nucleosomes, chromatin. DNA molecules in a series of
Looped domains – units of function. Extra nuclear DNA Mitochondrial
And Chloroplast DNA. Cell Signaling – Communication between the
Cells and their environment: Characteristics of the cell signaling system,
Second messenger (Plant and animal cells) and G protein coupled
Receptors. Receptors of tyrosine kinases, Signals that originate from
Contact between cell structure and substratum, Convergence,
Divergence and crosstalk among different signaling pathways, other
Signaling pathways.

Unit 5 Regulation of gene action: 9

Regulation of gene action in Prokaryotes-enzyme regulation of gene
Action, operon hypothesis, example of lac operon. Regulation of gene
Expression in simple eukaryotes. Eukaryotic gene control, hormonal
Regulation, regulations by histones, regulation by heterochromatin.
Recombination: Mechanism; forms of recombination

Total 45

References:

1. Weaver, F. Robert, Hedrick, W.Philip. (1997) 3rd ed. Genetics. Em.C. BrownPublishers.
2. David Freifelder (1983) Jones & Bartlett publishers. 2ed Molecular biology. Reprint (1993) Narosa Publishing House.
3. Gardner, Simmons 8 ed. Principles of Genetics.
4. Karp, G. 1999. Cell and Molecular Biology – Concepts and experiments.2 nd Edn. Harris, D (ed.), John Wiley & Sons, NewYork.
5. Kleinsmith, L. J. & Kish, V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York.
6. Alberts, B., Bray, D., Lewis, ., Raff, M., Roberts, K. Watson, J.D. (eds.) 1994. Molecular Biology of the Cell. 3rd end., Garland Publishing, Inc., New York.
7. De Robertis, E.D.P, and De Robertis, E. M.F. 1995. Cell and Molecular Biology. 8th edn., B.I. Waverly Pvt. Ltd., New Delhi.

GENETIC ENGINEERING AND CLONING VECTORS

L T P C

3 0 0 3

Unit 1: DNA & Basics of Recombinant DNA Technology 10

Structure of DNA: A-,B-,Z-, and triplex DNA, measurement of properties, Spectrophotometer, Restriction analysis: Types of restriction enzyme, Type

I, II and III, restriction modification systems, type II restriction endonucleases And properties, isoschizomers and neoschizomers, mct/mrr genotypes, Cohesive and blunt and ligation, linkers, adaptors, homopolymeric tailing. Labeling of DNA: Nick translation, random priming, radioactive and non Radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial Alkaline phosphates, polynucleotide kinase. Hybridization techniques: Northern Southern and colony hybridization, Fluorescence in situ hybridization Restriction maps and mapping techniques, DNA finger printing, chromosome Walking & Chromosome jumping, DNA-protein interactions: Electro Mobility Shift, DnaseI foot printing, methyl interference assay.

Unit 2: Cloning Vectors 8

Gene Cloning Vectors: Plasmids, bacteriophages, cloning in M13 mp Vectors, phagemids, Lamda vectors; insertion and replacement vectors, EMBL, λ DASH, λ gt10/11, λ ZAP etc. Cosmid vectors, Artificial chromosome vectors (YACs, BACs), Animal virus derived vectors-Sv-40, caccinal/bacculo & retroviral vectors. Expression vectors; pMal, GST,Pet – based vectors. Protein purification; His-tag, GST-tag, MBP-tag etc. Restriction proteases, intein-based vectors. Inclusion bodies methodologies to reduce formation of inclusion bodies. Baculovirus and pichia vectors system.

Unit 3: Cloning Methodologies 8

Insertion of Foreign DNA into Host cells: Transformation, transfection: chemi

And physical methods, liposomes, microinjection, electroporatic biolistics, Somatic cell fusion, gene transfer by pronuclear microinjection, features of Ti and Ri as vectors. Cloning and expression in yeasts (*Saccharomyces*, *Pichia* etc animal and plants cells, methods of selection and screening, cDNA And genome cloning, expression cloning, jumping and hopping libraries, Southwestern and western cloning, yeast two hybrid system, phage display, Construction of cDNA libraries in plasmids and screening methodologies, Construction of cDNA and genomic DNA libraries in lambda vector. Principles in maximizing gene expression, site-directed mutagenesis.

Unit 4: PCR and its Applications

9

Primer design, Fidelity of thermostable enzymes, DNA polymerases, Multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, Hot start PCR, colony PCR, cloning of PCR products, T-Vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension and SOEing, site specific mutagenesis, PCR in molecular diagnostics, viral And bacterial detection, PCR based mutagenesis.

Unit 5: Applications

10

Sequencing methods: Enzymatic DNA sequencing, chemical sequencing of DNA, principle of automated DNA sequencing, RNA sequencing. Chemical Synthesis of oligonucleotides. Gene silencing techniques: introduction to siRNA And siRNA technology, micro RNA, construction of siRNA vectors, principle And application of gene silencing. Gene knockouts and Gene Therapy: Creation of knock out mice, disease model, somatic and germ-line therapy in

vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting.

Total 45

Books:

1. Principles of gene manipulation by R.W.Old & S.B.Primrose. Blackwell science
2. Molecular Biotechnology by Bernard R. Glick & Jack J. Pasternak.
3. Recombinant DNA by James Watson, Michael Gilman, Jan Witkowski. Scientific American Books
4. Basic Biotechnology by Cokin Rateldge & Bjorn Christiansen, Cambridge University press.
5. Biotechnology by John E.Smith. Cambridge University press
6. Molecular Biology of Gene by Watson (Benjamin Cummings), publishing company inc.
7. Molecular cloning, 3 volumes by Sambrook & Russell, SCML Press.
8. Molecular biology by David & Freifelder – John & Barlett, Narosa publishing house
9. From genes of Genomes by Jeremy W.Dale & Malcolm Von Schantz John-Wile publishers
10. A passion for DNA-genes, genomics & society by James D. Watson. Cold Spring Harbor Laboratory.

INDUSTRIAL BIOTECHNOLOGY

L T P C

3 0 0 3

Unit 1 Introduction to industrial Biotechnology 9

Introduction to industrial Biotechnology, basis principles of fermentation Technology, Screening and Isolation of Microorganisms, maintenance of strains improvement (Mutant selection, Recombinant DNA methods). Fermentation Media, Natural and synthetic Media, Sterilization techniques – Heat, Radiation and Filtration method.

Unit 2 Fermentation 9

Fermenters, Process of Aeration, Agitation, Temperature regulation and Filtration method. Type of Fermentation, Solid State, submerged fermentation And continuous fermentation, Immobilized enzyme and cell bioreactors. Process Development – Shake flask fermentation, Down stream processing (DSP), Disintegration of cells, Separation, Extraction, Concentration and purification of products

Unit 3 Microbiological fermentation 9

Production of Microbial products, Brief account of the following Products obtained by industrial microbiological fermentation, Alcohol, Alcoholic Beverage – Beer Organic acid – Citric acid, Antibiotic – Penicillin, Amino acids -Gultamic acid, Vitamin-B12, Brief account of Steroid biotransformation

Unit 4 Enzyme Biotechnology 9

Characteristics of enzymes – amylases. Industrial uses of enzymes – Detergents, Leather, Beverage, food and Pharmaceutical Bioreactors for Enzyme production – Stirred tank, membrane reactors and continious

BIOETHICS, IPR AND BIOSAFETY

L T P C

3 0 0 3

Unit 1 Introduction

Introduction: Historical development of Human Rights and Human Relations –International and National. International Instruments: United Nation Commission for Human Rights.

Unit 2 Human Rights 9

European Convention for Human Rights UDHR, Civil and Political Rights- National Instruments: National and State Instruments: Development of Human Rights – Article 21 of Indian Constitution.

Unit 3 Human Relations 9

Human Relations: Political relations Ethnic and Communal relations, Socio-cultural relations, Organisation relation etc., and related Human Rights. Economics of Human Rights and Relations- adam Smith's thoughts on moral sentiments- Economic philosophy of Thiruvalluvar.

Unit 4 Bioethics 9

Impact of gene cloning and Bioethics. Intellectual Property Rights (IPR) and Patents, biosafety, containment facilities for Genetic Engineering experiments, Regulations on field experiments and release of GMO's (Genetically Modified Organisms), labeling of GM (Genetically Modified Foods).

Unit 5 Student Activity 9

Recommended Texts:

1. Trayror, P.C., Frederic R. and Koch, M. 2002. Biosafety. Board of Trustees, Michigan State University, USA.
2. Benjamin Lewin, 2000, Genes VII, First edition, Oxford, New York.
3. Paul R.C., 2000. Situations of Human Rights in India. Efficient offset printers.
4. Beauchamp, T.L. and Leroy, W. 1999. Cotemporary issues in bioethics. Wardsworth publishing Co. Belmont, California.
5. Bishop. M.J. and Rawlings, 1987, Nucleic acid and protein sequence analysis, First, IRL Press, England.
6. Krech, D., David, K., Crutchfield, R.S. and Ballachey E.L. 1962. Individual in society. A textbook of social psychology. Mc Graw-Hill

Reference Books

1. William, S Klug and Michel, R Cummings, 2003, Concepts of Genetics, Seventh edition, Pearson Education, Singapore.
2. Paul, R.C., 2000 Situations of Human Rights in India, Efficient Offset Printers,
3. Marc Galanter, Social Inequality
4. Adam Smith, Theory of Moral Sentiments
5. Thiruvalluvar, Thirukural: Arathuppal and Porutpal
6. Kretch & Crutchfield, Social Psychology

TISSUE ENGINEERING

L T P C

2 1 0 3

Unit 1 Introduction

Introduction to tissue engineering:-Basic definition; current scope of Development; use in therapeutics and in vitro testing- In vitro organogenesis

Unit 2 Structure and organization of tissues 9

Epithelial, connective; vascularity, lymph. Basic developmental biology.

Stem Cells introduction, Hematopoiesis, Es cells, Blood from Es cells, Basic Wound healing, Stem cells & bone

Unit 3 Transport Properties of Tissues 9

Introduction to mass transfer – Diffusion of simple metabolites, Diffusion & Reaction, Diffusion & reaction of proteins, General aspects of cells in Culture; transport limits on 3D cultures

Unit 4 Extracellular matrix 9

Cell-Matrix & cell-Cell interactions, Differential cell adhesion & tissue Organizational Scaffolds & tissue engineering – Basic properties

Unit 5 Cell migration and transplantation 9

Basic transplantation immunology, Control of cell migration in tissue engineering, TBA, Cell transplantation for liver tissue engineering

Total 45

References:

1. Tissue Engineering – B.O. Palsson and S.N. Bhatia, Pearson Prentice Hall, Upper Saddle River, NJ, 2004.
2. Principles of Tissue Engineering, Second Edition (Hardcover) by Robert Lanza (Editor), Robert Langer (Editor), Joseph P. Vacanti (Editor)

PRACTICAL- CYTOGENETICS AND MOLECULARBIOLOGY

L T P C

0 0 4 2

1. Instrumentation methods of cell biology
2. Microtomy
3. Observation of Prokaryotic and Eukaryotic cells and cell types.
4. Living Cells/Temporary/Permanent preparations. Histochemical techniques
5. Squash preparation of giant chromosome of salivary gland of Chironomous larva.
6. Squash preparation of onion root tip.
7. Subcellular fractionation and biochemical/enzymyological analysis
8. Cytochemical study of cells/cell types using specific dyes/reagents.
9. Immunocytochemical analysis for specific cellular constituents.
10. Metaphase chromosome preparations and preliminary banding techniques.
11. Isolation, determination, purification and separation of protein, carbohydrates,
12. lipids, DNA and RNA.
13. Production of enzyme (amylase)
14. Immobilization of cells and enzymes by Calcium alginate method
15. Kinetic analysis of enzymes
16. Thin layer chromatography
17. Paper chromatography
18. Poly acrylamide gel electrophoresis

PRACTICAL- GENETIC ENGINEERING

L T P C

0 0 4 2

1. Isolate genomic DNA from *Bacillus subtilis* genome.
2. PCR amplification of *ScoC* gene and analysis by agarose gel electrophoresis.
3. Preparation of Plasmid, pET – 28a from *E. coli* DH5α and gel analysis.
4. Restriction digestion of vector (gel analysis) and insert with *Nco* I and *Xho* I.
5. a. Vector and Insert ligation
b. Transformation in *E.coli* DH5α
6. Plasmid isolation and confirming recombinant by PCR and RE digestion
7. Transformation of recombinant plasmid in BL21 (DE3).
8. Induction of *ScoC* protein with IPTG and analysis on SDS - PAGE
9. Purification of protein on Ni-NTA column and analysis of purification by SDS – PAGE.
- 10.a. Random primer labeling of *scoC* with Dig-11-dUTP
b. Southern hybridization of *B. subtilis* genome with probe and non – radioactive detection.

SEMESTER - III

PLANT & ANIMAL BIOTECHNOLOGY

L T P C

3 0 0 3

Unit 1 Introduction 9

Plant Biotechnology Overview – concept, definition and landmarks, Algal Biotechnology- qualitative and quantitative improvement in economically important algae, qualitative and quantitative improvement in economically important fungi (higher fungi) Seed plant biotechnology – qualitative and quantitative improvement in economically important seed plants

Unit 2 Micropropagation 9

Advantages of tissue culture techniques over conventional, methods for crop improvement, Plant growth regulators/retardants in plant tissue culture, Explant preparation- regeneration by organogenesis and somatic embryogenesis from callus and cell suspension culture, direct embryogenesis.

Unit 3 Transgenics Plants 9

Transgenics for stress tolerance, secondary metabolites, crop improvement, Somaclonal variation, somatic hybridization, haploids in plant breeding, Increase in productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency, biotic and abiotic stress tolerance- insects, fungi, bacteria, viruses, weeds, drought, salt, flooding and temperature, quality improvement of protein, lipids, carbohydrates. Plantibodies, Plant-derived vaccines.

Unit 4 Animal Biotechnology 9

Overview-livestock breed and their productivity, artificial breeding-methods and hazards, Genebanking, conservation and exchange in India. Cell

culture-types, maintenance, and kinetics of growth, genetic and applications. Stem cells – principles for identification, purifications assessment of proliferation heterogeneity, long-term maintenance and characterization.

Unit 5 Transgenic animals 9

Artificial breeding – in vitro fertilization and embryo transfer, artificial insemination, Germ cell storage, genetic modifications-methods, integration of microinjected Sequences, into embryos – case study on mice, problems after developing transgenic Animals. **Total 45**

Text Books

1. Revolution in Biotechnology – J.L. Marx
2. Animal Biotechnology – Ramadoss
3. Animal Tissue culture by Ian Freshney
4. In vitro culture of Animal cells Biotol Series

Reference Books

1. Plant Molecular biology – Grierson and S.N. Covey
2. Plant Genetic Engineering – D.H. Doods
3. Recombinant DNA (2nd ED) – J.D. Watson M. Gillman, J. Witknowski and M. Zoller (1992) Scientific American Books NY.
4. Genetic Engineering of crop plants – (Eds) G.W. Lycett and D. Grierson
5. Plants, genes and agriculture – M.J. Chrispeels and D.F. Sadava Jhones and Bartlett.

IMMUNOLOGY AND IMMUNOTECHNOLOGY

L T P C

3 0 0 3

Unit – I Biology of the Immune system

9

Biology of the immune system; Phylogeny of the immune system; innate immunity; acquired immunity; organization and structure of lymphoid organs; cells of the immune system. Molecular components of an immune system; Nature and biology of antigens; structure, classes and functions of antibodies; Antigen receptors; Effectors components of an immune response-pathways of complement systems.

Unit –II Antigen and antibodies interactions

9

Antigen and antibodies interactions – Antibody affinity-avidity-specificity-cross reactivity; Antigen processing and presentation through MHC I and II and BCR; immunological tolerance. Assessment of delayed hypersensitivity reactions. Antigen-isolation, purification and characterization of various antigens and haptens from pathogens and other biological molecules by biophysical and chemical and affinity separation methods.

Unit –III : Isolation And Characterization of Cells

9

Purification of mononuclear cells from peripheral blood; Isolation and characterization of T cell subsets; B cells and macrophages; Fluorescent activated cell sorter (FACS); Mitogen and Antigen induced Lympho-proliferation assay; cell mediated Lympholysis; mixed Lymphocyte reaction. Macrophage cultures; Assay for macrophage activation; Isolation of dendritic cells; In situ & In vivo characterization of cells from tissues; generation of T cell clones; HLA typing.

Unit – IV Antibodies

9

Hybridoma and monoclonal antibody production; immunodiagnosis & Applications of monoclonal antibodies in biomedical research; human monoclonal antibodies; Catalytic antibodies; complement fixation test; assessment of immune complexes in tissues. Production and purification of antibodies, Quantitation of immunoglobulin by RID, EID and nephelometry.

Unit – V Vaccines

9

Biology and assay of cytokines; Vaccine technology including DNA vaccines; Identification of T and B epitopes for vaccine development; immune technology and infectious disease. Immunoscreening of recombinant library.

Total 45

Recommended Texts:

1. Tak W. Max and Mary Saunders 2005, The Immune Response, Basic and Clinical principles, First Edition: Academic press
2. R. A. Goldsby, T. J. Kindt & B.A. Osborne 2000. Immunology, Freeman and Company.
3. Janes Kuby 1997. Immunology, Third edition, W. H. Freeman and company, New York.
4. I. Roitt. 1996 Immunology Black well Scientific Publication.

Reference Books:

1. T. G. Parslow, D.P. Stites, A.L. Terr 2001 Medical Immunology, Tenth edition, MCGraw-Hill publishing.
2. H. Zola 2000. Monoclonal antibodies. Bios Scientific publisher Ltd.
3. Joshi K.R. & Osama, N.O. 1998 Immunology, Agro Botanica Bikaner.
4. Ivan M. Roitt and peter J. Delvis 1997, Essential Immunology, Ninth edition Blackwell science pub. USA.
5. Ransohoff Richard et al., 1996 cytokines and the CNS, CRC press Boca Ration.
6. Tizard Lan, R. 1995 Immunology an introduction, Saunders college Pub., Philadelphia
7. Current protocols in immunology, 3 voluems Wiley publication, 1994.
8. D.M. Weir, 1992, Immunological techniques. Vol. 3 Black Well scientific publication.
9. Lesley Janes Eales, Immunology for Life Scientists, Second edtion, Wiley Pub.
10. Steward, M.W., 1984, Antibodies. Their Structure and function, Chapman and Hall, New York.

Indian Authors

1. Nandini Shetty, 1996 Immunology; introductory textbook New Age international, New Delhi.
2. S.C. Rastogi. 1996. Immunodiagnostic Principles and Practices. New Age International(P) Ltd., Publishers. New Delhi, Chennai.

INTRODUCTION TO BIOINFORMATICS AND SOFTWARE'S

L T P C

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Unit : 1 Basic Sequence Analysis software: 9

Working principles, EMBOSS suite and Sequence Analysis, Homology search using BLAST and FASTA SEARCHES, ORF finder, DOTPLOT for graphical sequence comparison.

Unit :2 Data Visualization Software 9

Working principles, BIOEDIT and interactive sequence editing, postscript file viewing using Ghostscript and Ghost, view, sequence Logo, BOSXHADE and TEXSHADE for colouring Alignments, Rasmol commands for structure alterations.

Unit : 3 Biology Workbench Environment 9

Workbench pipeline Architecture, SDSC workbench suites, CLC workbench suites, Artemis and Sequence Analysis, GCG seqlab Environment, components of Whatif, Webinterface, Comparative genomics using Vista Server.

Unit : 4 Conversation tools 9

Sequence format conversion Tools- READSEQ, structure format conversion tool- OPEN BABEL

Unit : 5 Software Installation and Maintenance 9

Biosoftware installation in varied platforms-Windows Environment, Unix Environment Environmental variables, Archiving, Unzipping, compilation and installing in linux/Unix Environment, introduction to X-Window. Trouble shooting.

Total 45

Reference Books:

1. Developing Bioinformatics Skills, Cynthia Gibas, Per jamback
2. Bioinformatics, Arthur A. Lesk.

ENZYMOLGY AND ENZYME TECHNOLOGY

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Unit I Enzyme technology **9**

Activity of enzymes Handling of enzymes Enzymes assays. Analysis of enzymes activity(methods), expression of the activity couples reactions. Isolation and purification of enzymes. Importance of pure enzymes. Separation of Isoenzymes.

Unit II Enzyme Kinetics **9**

Velocity of reaction of order of a reaction, progress curve for enzyme catalysed reactions. Factors influencing velocity of enzyme catalysed reaction. Michaelis Menten Kinetics, Km and Vmax. Effect of pH, temperature on enzymatic reactions. Anomalous kinetics of competitive and non-competitive inhibition. End product inhibition with examples.

Unit III Coenzymes & Cofactors **9**

Substrate enzyme relationship. Classification of co-enzymes as group transfer, hydrogen transfer, coenzymes, structures of coenzymes function of nucleotide coenzymes, CoA, NAD.NADP, FMN/FAD, Biotin, Folic acid, Vit B12,. Biosynthesis of puridine and flavin nucleotides and CoA.

Unit IV Mechanism of Enzyme action **9**

Enzyme specificity, Active site, study of mechanism of enzyme reaction – pathway of enzyme catalysed reactions, Mapping of active site, Mechanisms at active site of enzymes-Covalent-catalysis, acid base catalysis. Proximity and orientation effect. Structure and mechanism of action of representative enzymes. Chymotrypsin and Ribonucleas. Regulation of enzyme activity-Covalent modulated regulatory enzymes. Allosteric regulation.

Unit V Enzyme Technology **9**

Application in Food and pharmaceutical industries-large scale enzyme extraction, purification and stabilization. Industrial application of carbohydrates, proteolytic enzyme, lignocelluloses degrading enzyme, pectin and pectic enzyme. Applications of enzymes in food industry. Clinical enzymology-serum enzymes in health and diseases. Immobilised enzyme technology – designer enzymes – Abzymes Biosensors-Ribzymes.

Total 45

References

1. Enzymes – Dixon & Webb
2. Biological Chemistry – Mahler & Cordes
3. Principles of Biochemistry – Lehninger.
4. Human Nutrition-Biochemical Basis of Inherited Diseases Fredrickson et.al
5. Alan Weissman, Hand Book of Enzyme Biotechnology; 2nd Edition

NANOBIOTECHNOLOGY

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Unit 1 : Nanomaterials

9

Biomineralised Inorganic Nanomaterial-Nanostructure and Dynamics of Biocompatible surfactant monolayers and bilayers-Biointerface, Bioconjugation, Biomatrix based on bioinspired phospholipid polymers.

Unit –I: Applications

9

Self assembly of ionic-complementary peptides and their applications in nanobiotechnology-from nanocluster assays to optical biochips for nanobiotechnology-Bioactive nanomaterials in bone grafting and tissue engineering-inorganic/polymers nanocomposites for dental restoration and bone replacement applications.

Unit –III Nanostructures

9

DNA based artificial nanostructures; Fabrication, properties and application-Nucleic acid engineered nanomaterials and their applications. Protein patterning for applications in biomaterials and biodevices.

Unit – IV Polymers

9

Polymers nanofibers and their applications in bioengineering – Functional polymers for bone tissue engineering applications – Applications of nanotechnology in tissue engineering.

Unit – V Applications in Pharma

9

Vesicles and liposomes in sensor technology –self assembling nanostructure injectable polymeric gels for drug delivery-Engineering surface erodible polyurethanes with tailored microstructure for controlled drug and protein delivery.

Total 45

Recommended Texts:

1. Challa S.S.R. Kumar (Ed). 2006. Biological and pharmaceutical nonmaterial's. Wiley-VCH Verlag Gmbh & Co., KgaA.
2. K.K. Jain 2006 Nanobiotechnology in Molecular Diagnostics: Current Techniques and Application Horizon Biosciences.
3. Niemeyer, C.M. Mirking C.A., (Eds.) 2004 . Nano biotechnology concepts.
4. Applications and Perspectives, Wiley- VCH, Weinheim

PRACTICAL
PLANT & ANIMAL BIOTECHNOLOGY

L T P C
0 0 4 2

Plant Tissue Culture

1. Preparation of Culture Media'
2. Callus induction
3. Micropropagation
4. Isolation of protoplast
5. Somatic embryogenesis
6. Regeneration of plantlets

Animal Cell Culture

1. Chick embryo fibroblast culture
2. Subculturing of cells
3. Karyotyping

PRACTICAL
IMMUNOLOGY AND IMMUNOTECHNOLOGY

L T P C

0 0 4 2

1. Immunization and collection of serum.
2. Radial immunodiffusion.
3. Ouchterlony double diffusion.
4. Immunoelectrophoresis.
5. Rocket Immunoelectrophoresis.
6. Immunodiagnosics (ELISA and Western Blotting).
7. Hemolysis.
8. Hemagglutination.
9. Preparation of tissue culture medium and membrane filtration.
10. Preparation of single cell suspension from spleen and thymus;
11. Trypsinization of monolayer and subculturing Cell counting and cell viability.
12. Macrophage monolayer from PEC and measurement of phagocytic activity.
13. Role of serum in cell culture and primary cell culture.
14. Blood film preparation and identification of cells.
15. Lymphoid organs and their microscopic organization.
16. Immunization, Collection of Serum; Double diffusion and immunoelectrophoresis;
Radial immuno diffusion, SDS PAGE
17. Purification of IgG from serum
18. Separation of mononuclear cells by Ficoll-Hypaque and analysis of T-cells
By Rosette Technique
19. Cell fusion with PEG
20. Con-A induced proliferation of thymocytes (by MTT method)

21.MTT assay for cell viability and growth

22.Western-blotting

23.ELISA

DISSERTATION & VIVA VOICE (PROJECT)

L T P C

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Project Duration - 6 months

Monitoring the progress - Once in a month