101: CELL BIOLOGY

UNIT I

1. Cell Membrane: Physicochemical Properties; Molecular Organization – asymmetrical organization of lipids, proteins and carbohydrates; Biogenesis and Functions
2. Transport of Small Molecules Across Cell Membranes: Types and Mechanism
3. Active Transport by ATP-Powered Pumps: Types, properties and mechanisms
4. Transport of proteins into mitochondria and chloroplast

UNIT II

1. Transport of proteins into and out of nucleus
2. Transport of proteins into endoplasmic reticulum
3. Transport by vesicle formation: Endocytosis and Exocytosis
4. Molecular Mechanism of vesicular transport

UNIT III

1. Intracellular Digestion: Ultra structure and Functions of Lysosomes
2. Cell Motility and Shape I: Structure and Functions of Microfilaments
3. Cell Motility and Shape II: Structure and Functions of Microtubules and Intermediate Filaments
4. Intracellular communication through cell junctions: Occluding junctions, Anchoring Junctions and Communicating Junctions

UNIT IV

1. Molecular Mechanism of Cell-Cell Adhesion: Ca^{++} dependent cell-cell adhesion
2. Molecular Mechanism of Cell-Cell Adhesion: Ca^{++} independent cell-cell adhesion
3. Extra-cellular Matrix of Animals: Organization and Functions
4. Extra-cellular Matrix Receptors on Animal Cells: The Integrins

UNIT V

1. Cell Signaling: Signaling via G-Protein linked and enzyme linked cell surface receptors, MAP Kinase Pathways, Interaction and Regulation of signaling pathways
2. Eukaryotic Cell Division Cycle: Different Phases and Molecular Events
3. Control of Cell Division Cycle: In yeast and mammalian cells
4. Apoptosis: Phases and significance, Morphological and Biochemical changes associated with apoptotic cells, Apoptotic Pathways and regulators

Practical Exercises

1. Sub cellular fractionation
2. Chromosome Preparation: Mitosis – Onion root tip, rat/mouse cornea, rat/mouse bone marrow, human lymphocytes
3. Chromosome Preparation: Meiosis – Rat/mouse testis, Grasshopper testis
4. Polytene chromosome preparation from Drosophila salivary gland
5. Identification of tissue typing: Histological preparation of tissue
6. Identification of different biomolecules in different tissues by histochemical techniques

**Reference Books**

1. Molecular Biology of the Cell, Alberts, *et al*
2. Molecular Cell Biology, Lodish, *et al*
3. Working with Molecular Cell Biology: A study Companion, Storrie *et al*
4. Cell and Molecular Biology: Concepts and Experiments, Gerald Karp
5. The Cell: A Molecular Approach, G.M. Cooper
6. The Word of the Cell, Becker *et al*
7. Cell Proliferation and Apoptosis, Hughes and Mehnet
8. Essential Cell Biology, Alberts *et al*
9. Biochemistry and Molecular Biology of Plants, Buchanan *et al*
10. Harpers Biochemistry Murray *et al*

*Note: All text books are of latest editions.*
UNIT I
1. Carbohydrates: Structure, classification, properties and functions
2. Home and heteropolysaccharides: carbohydrate derivatives
3. Lipids: Classification, structure, properties and functions
4. Lipids with special biological functions

UNIT II
1. Amino acids: Structure, classification, abbreviations, properties and functions
2. Peptides and polypeptides
3. Synthesis of peptides and protein sequencing
4. Proteins: Properties, covalent structure, secondary, tertiary and quaternary structure

UNIT III
1. Enzymes: Classification, mechanism of action, allosteric enzymes, multienzyme complex
2. Enzyme kinetics: Basic concepts
3. Water soluble vitamins: Structure, distribution, interaction and biological functions (mechanism of action not included)
4. Fat soluble vitamins: Structure, distribution and functions

UNIT IV
1. Nucleotides: Structure of purine and pyrimidine bases, nucleosides, nucleotides
2. DNA: Structure and Conformation
3. DNA: denaturation, degradation, modification, repair, recombination and rearrangement
4. RNA: Structure, types and functions

UNIT V
1. Animal hormones: Structure and biological roles
2. Plant hormones: Structure and biological functions
3. Plant phenolics: Classification and functions
4. Alkaloids: Classification and functions

Practical Exercises
1. Titration of amino acids
2. Colorimetric determination of pKa
3. Model building using space filling/ ball and stick models
4. Reaction of amino acids, sugars and lipids
5. Quantitation of proteins and sugars
6. Analysis of oils: iodine number, saponification value, acid number

Reference Books
1. Principles of Biochemistry by Nelson, Cox and Lehninger
2. Biochemistry by G.Zubay
3. Biochemistry by Stryer
4. Biochemistry by Garrett and Grisham
8. Laboratory Techniques in Biochemistry and molecular Biology, Work and Work

Note: All texts are of latest editions.
UNIT I
1. Classification of Microorganisms: Basis of microbial classification, Haekel three kingdom, Whittaker’s five kingdom concept.
2. Morphology and fine structure of eubacteria and archeobacteria cell wall, cytoplasmic membrane and other organelles.
3. Pure culture techniques and preservation methods.
4. Preparation of Culture media, microbial staining.

UNIT II
1. Sterilization: Physical and chemical methods
2. Microbial Growth: Bacterial growth curve, Mathematical expression, measurement of Growth and factors affecting growth
3. Microbial Nutrition: Nutritional classification of Microorganisms, common nutritional requirements, mode of nutrition, transport of nutrients across the bacterial membrane

UNIT III
2. Structure and morphology of Bacteriophage, Lytic and lysogenic cycle.
3. Life cycle of DNA Viruses: SV40, RNA Viruses: Retroviruses
4. Cyanobacteria: General account and their importance

UNIT IV
1. Infection and disease, types of Infection, Mechanism of pathogenicity
2. Bacterial Diseases: Staphylococcus and Clostridial food poisoning, Salmonellosis Shigellosis
3. Fungal diseases: Histoplasmosis, Aspergillosis
4. Viral diseases: Chicken pox, Hepatitis B, and Poliomyelitis

UNIT V
1. Mycoplasmas and diseases caused by them
2. Bacterial Recombination: Transformation, Conjugation, Transduction, Plasmids and transposons
3. Chemotherapeutic agents: Classification of antibiotics, Broad spectrum antibiotics Antibiotics from prokaryotes
4. Anti-fungal and antiviral antibiotics, mode of action of antibiotics and resistance to antibiotics

Practical Exercises
1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms
3. Isolation of pure cultures from soil and water.
4. Growth; Growth curve; Measurement of bacteria population by turbidometry
and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.
5. Microscopic examination of bacteria, Yeast and molds and study of organisms by
   Gram stain, Acid fast stain and staining for spores.
7. Assay of antibiotics and demonstration of antibiotic resistance.
8. Analysis of water for portability and determination of MPN.
10. Biochemical characterization of selected microbes.
11. One step growth curve of coliphage.

Reference Books

1. General Microbiology, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter,
   P.R. The MacMillan Press Ltd.
2. Brock Biology of Microorganism, M.T. Martinke, J.M. and Parker,
   J. Prentice-Hall.
6. Microbiological Applications, (A Laboratory Manual in General Microbiology) Benson, H.J. WCB:
   Wm C. Brown Publishers

Note: All text books are of latest editions
104: PLANT BIOCHEMISTRY

UNIT I
1. Specialized plant organelles: Cell plate, Cell wall Chemical and physical composition, biosynthesis, primary and secondary cell walls, Plasmodesmata, Plasids- Types and functions, Importance of vacuoles and microbodies, Meristematic cells at root quiescent zone
2. Absorption, adsorption and transport of water and ions in plants
3. Translocation of inorganic and organic substances
4. Structure and biogenesis of organelles involved in photosynthesis in plants

UNIT II
1. Chloroplast membrane and molecular organization of thylakoids, proton gradient and electron transfer in chloroplasts of plants and in purple bacteria-difference from mitochondria
2. Light receptors: Chlorophyll, light harvesting complexes, bacteriorhodopsin as ion pump
3. Photosystem I and II: Location, mechanism of energy transfer between photosystems, ferredoxin, plastocyanin, plastoquinones and carotenoids
4. Hill reaction and photophosphorylation

UNIT III
1. The Calvin Cycle: Evidence, mechanism and stoichiometry, role of light in activation of dark phase enzymes
2. Photosynthesis: Mechanism and regulation
3. The C4 mode of photosynthesis: Mechanism, stoichiometry and purpose, difference from C3 in relation to plant productivity
4. C3 and C4 metabolic pathways as they relate to plant productivity

UNIT IV
1. Biological Nitrogen Fixation: Formation of ammonia, conversion of nitrate to ammonia, assimilation and secondary assimilation of ammonia, inhibitors
2. Molecular properties of nitrogenase system, nif genes and their regulation, applications of synthetic biology, nitrogen fixation
3. Molecular effects and mechanism of action of Auxin and Gibberellic Acid
4. Molecular effects and mechanism of action of Auxin and Gibberellic Acid

UNIT V
1. Secondary metabolites: Plant alkaloids: Distribution, localization and biosynthesis of true alkaloid structures, biological functions
2. Plant phenolics: Nature, distribution, biosynthesis and regulation of phenolics, phenolic acids, hydroxycinnamic acid, phenylpropanes, quinines, xanthones, stilbenes, flavonoids, bioflavanoids, lignins and tannins, biological functions
3. Biochemistry of seed development and fruit ripening
4. Defense system in plants

Practical Exercises
1. Estimation of plant proteins
2. Estimation of plant lipids and carbohydrates
3. Isolation of plant pigments, their analysis and determination of absorption Maxima
4. Chloroplast isolation
5. Hill Reaction
6. Estimation of nitrogenase
7. Estimation of nitrate reductase: in vivo method
8. Fruit ripening
9. Estimation of total phenolic compounds
10. Estimation of anthocyanin pigments

Reference Books
1. Handbook of Photosynthesis by Mohammad Pe Sarakie
2. Plant Physiology by Salisburry and Ross
3. Introduction to Plant Biochemistry by Goodwin and Mercer
4. Seed: Physiology of Development and Germination by Bewley and Balck
5. Biochemistry of Energy Utilization in Plants by Blakie
6. Plant Biochemistry by Dey and Harborne

Note: All text books are of latest editions

105: Lab Course I

Consists of practical exercises listed out under 101 & 102

106: Lab Course II

Consists of practical exercises listed out under 103 & 104

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