

Core Course II: Biomolecules and Cell Biology (Credits: Theory-4, Practical-2)

THEORY

(60 credit hrs)

Unit 1: Biomolecules (15 credit hrs)

Types and significance of chemical bonds; Structure and properties of water; pH and buffers.

Carbohydrates: Nomenclature and classification; Monosaccharides ; Disaccharides; Oligosaccharides and polysaccharides.

Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit 2: Bioenergetics & Enzymes (15 credit hrs)

Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule.

Enzymes : Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit 3: The cell , Cell wall and plasma membrane (8 credit hrs)

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and

facilitated transport, endocytosis and exocytosis.

Unit 4: Cell organelles & Cell division (22 credit hrs)

Nucleus: Structure-nuclear envelope, nuclear pore complex (modern concept), nuclear lamina, molecular organization of chromatin; nucleolus.

Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.

Endomembrane system: Endoplasmic Reticulum – Structure, Function & Types; targeting and insertion of proteins in the ER, protein folding, processing (elementary idea); Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle-checkpoints, role of protein kinases.

PRACTICAL

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.

2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*/*Crinum*.
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cytochemical staining of : DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Suggested Readings

1. Campbell, MK (2012) **Biochemistry**, 7th Ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) **Biochemistry Illustrated**, 4th Ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) **Biochemistry: A short course**, 2nd Ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) **Biochemistry**, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008) **Lehninger Principles of Biochemistry**, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). **Cell Biology**, John Wiley & Sons, U.S.A. 6th Edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). **Becker's World of the Cell**, Pearson Education Inc. U.S.A. 8th Edition.
8. Cooper, G.M. and Hausman, R.E. (2009) **The Cell: A Molecular Approach**. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) **The World of the Cell**. 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco