

## **BSH402 CELL BIOLOGY**

### **Course Outcomes:**

*Upon successful completion of the course, students will be able to:*

- CO 1. Know the ultrastructural organization and functions of organelles of prokaryotes and eukaryotes.
- CO 2. Comprehend the general structure and molecular organization of chromosomes.**
- CO 3. Gain theoretical knowledge how to use basic tools and techniques such as microscopy, centrifugation, autoradiography and centrifugation
- CO 4. Explain the physiochemical properties of biological membranes with structural and functional insights.
- CO 5. Understand the components of cell cycle control, mechanisms of cell division, apoptosis and senescence.
- CO 6. Understand how cells communicate one another and role of various messenger molecules in signal transduction.

### **Unit I (13 hours)**

Ultrastructure of prokaryotic and eukaryotic cells: Ultrastructure, organization and functions of cell organelles: Endoplasmic reticulum, liposomes, Golgi complex and protein sorting, ribosomes and nucleus; Structure of mitochondrion, chloroplast - their genetic organization and their semiautonomous nature. Secretory and endocytotic pathway. Cytoskeleton-microtubules, microfilaments, intermediary filaments. Centriole, cilia, flagella and cell motility. **Eukaryotic chromosome** - Ultrastructure and molecular organization. Nucleosome model of chromatin structure, Heterochromatin and Euchromatin, Ultrastructure of Giant chromosomes, Structure and function of centromere and telomere. Microscopy: principles and applications of Light, Phase contrast, fluorescence, laser confocal, scanning and transmission electron microscopy. Autoradiography, cytophotometry and flowcytometry and centrifugation. Cytochemical and histochemical staining techniques.

### **Unit II (13 hours)**

RBC as a Model membrane. Various models for membrane structure; Singer and Nicolson's model. Physicochemical properties of biological membranes – compositions, molecular organization, Membrane asymmetry – lipids, proteins and carbohydrates, lateral diffusion, membrane domains – caveolae, rafts. Transport across biomembranes- Energetics of membrane transport, Donnan membrane equilibrium, simple diffusion, osmosis, facilitated diffusion and active transport. Carrier proteins, Ion channels (voltage- and ligand- gated), Bacterial  $K^+$  leak channel & aquaporin channels. Electrical properties of membranes- Membrane potential, Mechanisms of nerve conduction. Transmission across electrical and chemical synapse. Mechanisms of endocytosis and exocytosis.

### **Unit III (13 hours)**

Components in cell cycle control - Cyclins, CDKs in yeast and mammalian cells. Check points in cell cycle. Mechanics of Cell Division- Different stages of mitosis. Cohesins and Condensins in chromosome segregation, Microtubules in spindle assembly, Structure of kinetochore, centrosome and its functions, Sister Chromatid separation. Cytokinesis role of actin & myosin in the generation of contractile ring. Meiosis – Significance. Chiasma formation - Synaptonemal complex. Recombination during meiosis - recombination nodules. Apoptosis: Mechanisms by internal signals and external signals, factors affecting apoptosis. Cell senescence.

### **Unit IV (13 hours)**

Various types of cell signaling-endocrine, paracrine, juxtacrine and autocrine; Signaling molecules – hormones, neurotransmitters, gases, lipids, peptides. Overview of receptors: types (membrane and intracellular receptors), structure and regulation - G-protein coupled receptors, Ion channel receptors, Tyrosine kinase linked receptors & Receptors with intrinsic enzyme activity (RTK) and nuclear receptors. General mechanisms of signal transduction by G protein coupled receptors and receptor tyrosine kinase, Second messengers-  $Ca^{2+}$ ,  $IP_3$ , DAG, cAMP & cGMP – cellular effects. Signaling pathways in development and differentiation (overview). Cell-cell adhesion, cell junctions; Extracellular matrix, extracellular matrix receptors. Cell-cell and Cell-matrix interaction (Integrins and selectins and their interaction).

