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 andapplications 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; Si ger 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), BacterialK^+ 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 – horm nes, neurotransmitters, gases, lipids, peptides. Overview of receptors: types (membrane and intracellular receptors), structure and reg ulation - 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).