MOLECULAR CELL BIOLOGY (HARD CORE COURSE)

Hours: 52

Course outcome

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

CO 1. Have a primer on cell membrane structure and function, prokaryotic and eukaryotic cells, membrane structure, transport, electrical properties and composition.

CO 2. Learn principles of techniques used to study cellular ultrastructure such as advanced microscopic techniques

CO 3. Understand sub-cellular organization

CO 4. Unravel chromatin and chromosomes

CO 5. Comprehend the fascinating world of cell division, mitosis, meiosis, cell cycle, molecular mechanisms that regulate life and death of a cell.

Unit I (13 hrs)

Membrane structure: Different models of membrane structure - Lipid bilayer, membrane proteins, membrane carbohydrate, transport across biomembranes, Mechanisms of endocytosis and exocytosis, Ion channels, Electrical properties of membranes; Nerve impulse transmission. Chemical composition of cell walls, cross linkage, porosity, tensile strength, turgor modifications in special types of cells, plasmodesmata, fluid transport between cells. Integrating cells into tissues: Cell adhesion, Cell junctions; Extracellular matrix, extracellular matrix receptors and signaling.

Unit II (13 hrs)

Subcellular Organization: Ultrastructural organization and functions of Golgi complex, endoplasmic reticulum, mitochondria, chloroplast, peroxisomes, lysosomes, ribosomes, nucleus and nucleolus. Structure, organization and types of eukaryotic chromosomes, Heterochromatin, euchromatin, telomeres, types of chromosomes, polytene chromosomes and lampbrush chromosomes. Chromosome dynamics during cell division: Mitosis, meiosis, microtubules, centrosome, centromere, kinetochore, metaphase and anaphase movements, motor proteins, cytokinesis. Cell cycle and its regulation. Apoptosis.

Unit III (14hrs)

Molecular biology of cancer: Abnormal cell growth: mechanism of transformation of cells. Genetic basis of Cancer, Physical and chemical carcinogenic agents; Viral and cellular oncogenes, tumor suppressor genes, Telomerases and their role in cancer. Developmental Biology: oogenesis, spermatogenesis, molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity. Egg activation, cleavage morphogenetic movements, Genetic basis of differentiation, molecular genetics of pattern formation - in *Drosophila*, *C. elegans*, *Xenopus* and mouse (in brief).

Unit IV (14hrs)

Cell signaling: Various types of cell signaling-endocrine, paracrine, juxtacrine and autocrine. Signaling molecules – hormones, growth factors, neurotransmitters, gases, lipids, peptides, Cellular responses to environmental signals in plants and animals; Receptors - extra cellular (G-protein coupled receptors, Ion channel receptors, Tyrosine kinase linked receptors & Receptors with intrinsic enzyme activity (RTK) and Intracellular receptors (cytosolic and nuclear receptors). Mechanisms of signal transduction and second messengers - Ca^{2+}, IP_3, DAG, cAMP & cGMP. Signalling pathways during development.