



**MANGALORE UNIVERSITY**  
**DEPARTMENT OF BIOSCIENCE**

**SOFT CORE COURSES**

**BSS404 ADVANCED CELL BIOLOGY**

**Course Outcomes:**

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

- Gain a deep knowledge in Cell Biology and its biomedical relevance.
- Know how scientists develop hypothesis by learning various models for membrane structure.
- Explain the physiochemical properties of biological membranes with structural and functional insights.
- Understand the components of cell cycle control, mechanisms of cell division and cellular senescence.
- Know factors affecting the programmed cell death (apoptosis).
- Understand how cells communicate one another and role of various messenger molecules in signal transduction.

**Unit I (13 hours)**

Introduction to Cell Biology. 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. RBC as a Model membrane. Transport across biomembranes- Energetics of membrane transport, Donnan membrane equilibrium, simple diffusion, osmosis, facilitated diffusion and active transport. Carrier proteins, Ion channels (voltage gated and transmitter gated) Bacterial -K<sup>+</sup> leak channel, & aquaporin channel, Electrical properties of membranes- Membrane potential, Mechanisms of nerve conduction. Transmission across electrical and chemical synapse. Mechanisms of endocytosis and exocytosis.

**Unit II (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. Programmed cell death (Apoptosis): Mechanisms by internal signals and external signals, factors affecting apoptosis. Cell senescence.

### Unit III (13 hours)

Various types of cell signaling-endocrine, paracrine, juxtacrine and autocrine; Signalling molecules – hormones, neurotransmitters, gases, lipids, peptides. Overview of classes of 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). General mechanisms of signal transduction by G protein coupled receptors and receptor tyrosine kinase, Second messengers-  $\text{Ca}^{2+}$ ,  $\text{IP}_3$ , DAG, cAMP & cGMP – cellular effects. Signalling 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).

### References:

1. Molecular cell biology, 6<sup>th</sup> ed. 2007, Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira & David Baltimore. WH. Freeman and company, New York.
2. Cell and Molecular Biology-Concepts and experiments. 6<sup>th</sup> (ed), John Harris, D(ed) Karp, G. 2010 . Wiley & sons, New York.
3. Principles of Cell and Molecular Biology. 2<sup>nd</sup> edn, Kleinsmith, L. J. & Kish, V.M. 1995. Mc Laughlin, S., Trost, K., Mac Elree, E. (eds.), Harper Collins Publishers, New York.
4. Molecular Biology of the cell. 5<sup>th</sup> edn.,Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K, Watson, J. D. (eds.) 2007. Garland Publishing, Inc., New York.
5. The Cell-A Molecular Approach. 5<sup>th</sup> ed. Cooper, Geoffrey M. Sunderland (MA): 2009, Sinauer Associates, Inc.;
6. Cell and Molecular Biology. 8th edn, De Robertis, E.D.P. and De Robertis, E.M.F. 2001. B. I. Waverly pvt. Ltd., New Delhi.
7. Developmental Biology. 6<sup>th</sup> ed Gilbert, Scott F.. Sunderland (MA): 2006, Sinauer Associates, Inc.;
8. Principles of Technique of biochemistry & Molecular biology, 2010, Edited by Keith Wilson & John Walker, 6<sup>th</sup> Ed. Cambridge University press.
9. Essential Cell Biology, Alberts *et al.*, 2010, 3<sup>rd</sup> edition, Garland Publishing, Inc., New York.
10. Lewin's Cells 2<sup>nd</sup> edition, Editors Lynne Cassimeris, V.R. Lingappa, George Plopper, 2011, Jones and Bartlett publishers Sudbury Massachusetts, USA,. Becker's World Of The Cell 8th Edition by Wayne M Becker, Lewis J Kleinsmith, Jeff Hardin Dorling 2012, Kindersley (India) Pvt Ltd