DISCIPLINE SPECIFIC ELECTIVE COURSE [ ] (BIOMED-DSE-[ ])
ADVANCED CELL BIOLOGY

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the Course
		Lecture	Tutorial	Practical/ Practice		
Advanced Cell Biology	4	2	0	2	XII Passed	Must have studied basic Cell Biology

Learning Objectives

- The main aim of this paper is to acquaint students with advancements in cell biology.
- Students will learn in detail about the intricate and specialized processes of transport of molecules within different compartments of cells.
- Understanding the mechanism of Cell survival, cell death and cell-renewal and the ways in which this regulation can be disrupted will help the students to understand the cause of many diseases particularly cancer.
- There have been great advancements in the techniques used for visualizing, separating and studying detailed ultra structure of cells. The course will familiarize the students with some such techniques during the practical sessions.

Learning Outcomes

- Students who successfully complete this course will acquire in depth understanding and advanced knowledge of a range of general and specialized areas in cell biology.
- They will develop insight into the complexities of intracellular transport.
- They will learn the molecular controls that govern the cellular microenvironment and cellular interactions maintaining tissue integrity.
- Students will appreciate the advancements in the techniques developed to understand the micro structure

SYLLABUS

Unit I: Transport of Molecules across Membrane and Organelles (12 Hours)

A. **Nucleus: U**nidirectional nature of protein export and import through nuclear pores. Mechanism for nuclear import and export of proteins (Ran-dependent and Ran-independent pathways)**.**

B. **Endoplasmic Reticulum and Golgi Complex:** Five topological classes of ER membrane proteins, Topogenic sequences: N-terminal signal sequences, internal stop-transfer anchor sequences, and Internal signal anchor sequences. Export of proteins (vesicular transport and significance of KDEL sequence),
C. **Mitochondria:** Protein transport to Outer membrane, intermembrane space, inner membrane and matrix. Role of N-terminal targeting sequences, Membrane receptors and Translocons complexes
D. **Peroxisomes:** Transport of proteins to peroxisomal membrane and matrix. PTS1-directed import of peroxisomal matrix proteins.
E. **Mechanism of Vesicular Transport :** Overview of the secretory and endocytic pathways of protein sorting, Molecular Mechanisms of Vesicle Budding and Fusion (v-SNAREs and t-SNAREs), Targeting GTPases and Rab Proteins, types of coated vesicles (COPII, COPI and Clathrin-coated vesicles), Role of Mannose 6-phosphate in protein sorting, Trafficking of soluble lysosomal enzymes from the trans-Golgi network and cell surface to lysosomes, Receptor-Mediated Endocytosis,

Unit II: Mechanism of Cell Death and Renewal (6 Hours)

Senescence (Role of CDK inhibitors, p16 and p21), Apoptosis (Intrinsic and extrinsic pathway, anti and pro apoptotic proteins like, BBC3, BCl2, SMAC and survivin), Necrosis, Autophagy, Stem cells (pluripotency, types of Stem cells and their applications).

Unit III: Tumor Cell Biology (6 Hours)

Causes of cancer. Differences between tumor and normal cells: Genetic makeup, uncontrolled proliferation. Genetic basis of cancer: Oncogenes (Ras, Myc), Tumor Suppressor genes (Rb- LOH, p53). Inherited cancer genes (BRCA1 and 2, CDH1), altered signaling pathways controlling cell proliferation,Cancer stem cells (origin, properties and role in tumor initiation).

Unit IV: Cell-Cell Adhesion, Extracellular Matrix (ECM) and Cancer Progression (6 Hours)

Cell interaction with neighboring cells and ECM (integrins, cadherins, fibroblasts, collagen, fibronectin). Alterations leading to metastasis: release of matrix metalloproteinases (MMPs),epithelial to mesenchymal transition (EMT)and angiogenesis.

Practical

(60 hours)

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. To isolate organelles by subcellular fractionation and validate the separated organelles by marker enzymes
2. To study the parts and working of confocal microscope
3. Flow cytometric analysis for separating the different type of blood cells
4. Flow cytometry based cell cycle analysis
5. To study cell viability/death by using trypan blue or MTT assay
6. Flow cytometry based detection of apoptosis
7. Preparation and culturing of cancer cell lines

8. To identify and study cancerous cells using permanent slides/ photomicrographs

9-10. To formulate the key hypothesis, summarize the results and the conclusions of the research papers on the related topics, and discuss the state-of-the-art of the research field and the contribution to the field and possible research applications of the main findings

11. To generate a graphical abstract to convey the scientific content of a research paper

Essential Reading:

- The Cell: A Molecular Approach, by Geoffrey M Cooper, Robert E Hausman, 15 Dec 2015
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Molecular Cell Biology Hardcover –by Harvey Lodish (Author), Arnold Berk , Chris Kaiser, Monty Krieger, Anthony Bretscher, 1 Apr 2016
- Molecular Biology of the Cell: by Bruce Alberts, Alexander Johnson, Julian Lewis. Publisher Garland Science, December 2014

Suggested Reading:

- James D. Watson (2014) 7th Edition. Molecular Biology of the Gene. Pearson, ISBN 0321762436, 9780321762436
- The Cell: A Molecular Approach, by Geoffrey M Cooper, Robert E Hausman, 15 Dec2015
- Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2016). 9th Edition. The world of the cell. San Francisco, USA: Benjamin Cummings Publishers, ISBN-13: 978 - 0321934925.
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.