

**SEMESTER V**  
**BSC (HONS.) BIOCHEMISTRY**

**DISCIPLINE SPECIFIC CORE COURSE – (DSC-13)**  
**MOLECULAR 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 (if any)
		Lecture	Tutorial	Practical/ Practice		
Molecular Cell Biology (BCH-DSC-501)	4	2L	0	2P	Class XII with Science and Biology	NIL

**Learning Objectives**

The course aims to provide advanced knowledge about the function of cellular organelles and the mechanism of protein sorting in the cell. It will also provide details of cellular communications in the cell and understanding of molecular regulation of cell growth and cell death. The course will outline the molecular details of cancer development and treatment.

**Learning outcomes**

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

1. Explain the process of protein trafficking in the cell and role of various regulatory proteins involved in the process.
2. Discuss the different modes of cellular communication in a multicellular organism
3. Explain the regulatory mechanisms involved in controlling the process of mitosis, meiosis, apoptosis, necrosis and autophagy.
4. Examine the molecular and genetic basis of cancer development and various molecular approaches used for cancer treatment.

**SYLLABUS OF DSC-13**

**BCH-DSC-501 : MOLECULAR CELL BIOLOGY**  
**SEMESTER - V**

**Theory (2 Credits)**

**Total Hours: 30**

**Unit I: Protein Sorting and Secretory Pathway**

**(7 Hours)**

Overview of the endomembrane system; Co-translational and post-translational targeting of proteins into Endoplasmic Reticulum; Protein Modifications, Folding and Quality Control in ER; Protein targeting to Golgi complex and Lysosomes; Exocytosis; Sorting of Proteins to Mitochondria, Chloroplasts and Peroxisomes.

## **Unit II: Cellular Signaling**

**(10 Hours)**

Chemical signaling- endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Hormone receptors- extracellular and intracellular. G protein coupled receptors, G proteins, second messengers- cAMP, cGMP, IP<sub>3</sub>, DAG, Ca<sup>2+</sup>, Effector systems- adenylyl cyclase, guanylyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases-EGF, Insulin and Ras-MAP kinase cascade. Non-receptor tyrosine kinase-erythropoietin receptor JAK-STAT pathway. Intracellular receptor family: Steroid hormone receptor and NO receptors.

## **Unit III: Cell cycle and Apoptosis**

**(8 Hours)**

Overview of the cell cycle; Stages of eukaryotic cell cycle; Events of Mitotic Phase and Cytokinesis; Role of cyclins and cyclin-dependent kinases; Molecular mechanisms of cell cycle regulation and Cell Growth; Meiosis and its regulation; Cell death: Apoptosis, Necrosis and Autophagy; Intrinsic and extrinsic apoptotic pathways; Regulation of apoptotic pathways.

## **Unit IV: Molecular Basis of Cancer Biology**

**(5 Hours)**

Types of cancer; Stages of cancer development; Properties of Cancerous Cells; Genetic basis of cancer; Cancer causing agents: radiations, chemical carcinogens and introduction to viral oncogenes; Role of cancer critical genes: oncogenes and tumor suppressor genes; Molecular approaches for cancer treatment.

### **2.3 Practical (2 Credits)**

**Total Hours: 60**

1. Isolation of organelles by subcellular fractionation and validation of separated organelles by marker enzymes.
2. Study the changes in heart rate (sympathetic response) on exposure to caffeine (cAMP mediated) in model organisms.
3. Preparation of hepatocyte primary culture and cell enumeration.
4. Study of cell viability/death assay by use of trypan blue and MTT assay.
5. Polyploidy in onion root tip by colchicine treatment.
6. Study of apoptosis through analysis of DNA fragmentation patterns.
7. Identification and study of cancerous cells using permanent slides and photomicrograph.

### **2.4 Essential readings:**

1. Cooper, G.M. (2018). The Cell: A Molecular Approach. (8<sup>th</sup> ed.). Sinauer Associates Inc: Oxford University Press. ISBN: 9781605357072
2. Karp, G., (2010). Cell and Molecular Biology: Concepts and Experiments (8<sup>th</sup> ed.). John Wiley & Sons. Inc. ISBN: 978-1-118-65322-7.
3. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of the Cell. (6<sup>th</sup> ed.). Garland Science. ISBN: 978-0815345244

4. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh. A., Martin, K.C., Yaffe, M., Amon, A. (2021). Molecular Cell Biology (9<sup>th</sup> ed.). W.H. Freeman & Company (New York). ISBN-13: 978-1319208523/ ISBN-10: 1319208525

**Suggested readings:**

1. Kleinsmith, L. J., Hardin, H., Wayne G., Becker, M. (2009). The World of the cell (7<sup>th</sup> ed.). ISBN-13: 978-0805393934 / ISBN-10: 0805393935.

**3. Keywords**

Protein Sorting, Protein Modification, exocytosis, Cellular communication, autophagy, mitosis, meiosis, Apoptosis, Necrosis, Cancer, Oncogenes, Chemotherapeutics.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.