

B.Sc. (Hons.) Microbiology

DISCIPLINE SPECIFIC CORE COURSE – 7: BASIC CONCEPTS OF 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		
MICROB-DSC301: BASIC CONCEPTS OF CELL BIOLOGY	4	3	0	1	Class XII pass with Biology/ Biotechnology/ Biochemistry	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- The major objective of this course is to introduce the students to the essentials of eukaryotic cell biology. The students will gain knowledge about the physical and chemical architecture of cells as well as structural and functional details of different cell organelles.
- To familiarize the students with cell cycle events, and mechanisms of cell communication and cell death. They will be educated about the hallmarks, etiology and diagnosis of cancers. They will be introduced to the cutting-edge science of stem cell technology, their production and various applications

Learning outcomes

The Learning Outcomes of this course are as follows:

- Student will be able to describe the structure of the cell wall and cell membrane, membrane transport mechanisms, cell-matrix and cell-cell interactions, and the importance of the cytoskeleton.
- Student will be able to describe the organization and functioning of various cell organelles and gain insights into the internal organization of the nucleus.
- Student will be able to discuss the mechanisms of protein sorting, intracellular trafficking, and protein export.
- Student will be able to analyse the structure of the plant and animal cell by microscopic observation and the ultrastructure of cell organelles by electron microscopy.

- Student will be able to demonstrate the fractionation of cell components by ultracentrifugation and describe cell sorting by flow cytometry.

SYLLABUS OF DSC-7

UNIT – I (12 hours)

Cell envelope and cell interactions: Structure and composition of bacterial, fungal and plant cell walls. Composition of plasma membrane: phospholipid bilayer, membrane proteins, glycocalyx. Membrane transport mechanisms: passive diffusion, facilitated diffusion (carrier proteins and channel proteins), active transport ($\text{Na}^+\text{-K}^+$ ATPase, ABC transporters). Components of extracellular matrix: polysaccharides, structural proteins, adhesion proteins. Cell-matrix interactions: cell surface receptors, focal adhesions, hemidesmosomes. Cell-cell interactions: adhesion junctions, tight junctions, gap junctions, plasmodesmata

UNIT – II (6 hours)

Cytoskeleton: structural organization of actin filaments, microtubule structure and dynamics, structure of centriole, cilia, flagella. Microtubule motor proteins: kinesins and dyneins.

UNIT – III (12 hours)

Structures and functions of nucleus and other cell organelles: Structure and function of nucleus and its components (nuclear envelope, nuclear lamina, nuclear pore complex). Internal organization of nucleus: heterochromatin, euchromatin, nucleolus. Structure and function of cell organelles: mitochondrion, chloroplast, ribosome, peroxisome, lysosome

UNIT – IV (15 hours)

Protein sorting and membrane trafficking: Structure of endoplasmic reticulum (smooth and rough, ER transmembrane proteins). Targeting and translocation of proteins across the endoplasmic reticulum, protein processing, folding and assembly. Brief overview of the role of endoplasmic reticulum in synthesis of lipids and assembly of phospholipid bilayers. Structure and organization of golgi apparatus. Protein glycosylation, protein sorting, and exocytosis. Signal sequences in transmembrane transport: nuclear localization signal, endoplasmic reticulum signal sequence

Practical component

30 Hours

UNIT 1: (20 hours)

Cell and cell organelles: Use of light microscopy and electron microscopy in studying cells. Study of the structure and function of a plant cell and an animal cell through microscopy. Analysis of the ultrastructure of cell organelles through electron micrographs: nucleus, plasma membrane, mitochondrion, chloroplast, ribosome, endoplasmic reticulum, golgi bodies, lysosome, centriole

Unit 2: (10 hours)

Cell fractionation and sorting: Principle and working of cell fractionation by density gradient centrifugation using virtual lab. Principle and working of cell sorting by flow cytometry using virtual lab. Analysis of cell cycle stages using flow cytometry.

Essential/recommended readings

Theory:

1. Molecular Cell Biology by H. Lodish, A. Berk, C. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, A. Amon and K.C. Martin. 9th edition. W.H. Freeman, UK. 2021.
2. Essential Cell Biology by B. Alberts, K. Hopkin, A.D. Johnson, D. Morgan, and M. Raff. 5th edition. W.W. Norton & Co, USA. 2019.
3. Karp's Cell and Molecular Biology by G. Karp, J. Iwasa and W. Marshall. 9th edition. Wiley, USA. 2019.
4. The Cell: A Molecular Approach by G.M. Cooper. 8th edition. Sinauer Associates, UK. 2018.
5. Cell Biology by T.D. Pollard, W.C. Earnshaw, J. Lippincott-Schwartz and G.T. Johnson. 3rd edition. Elsevier, USA. 2016.
6. Becker's World of the Cell by J. Hardin and G. Bertoni. 9th Edition. Pearson, USA. 2015.
7. Cell and Molecular Biology by E.D.P. De Robertis. 8th edition. Lippincott, Williams and Wilkins, USA. 2006.

Practicals:

1. A Cell Biology Manual by J. Francis. Kendall/Hunt Publishing Co, USA. 2022.
2. Practical Laboratory Manual- Cell Biology by A. Gupta, B.K. Sati. Lambert Academic Publishing, USA. 2019.
3. Cell Biology Practical Manual by R. Gupta, S. Makhija and R. Toteja. Prestige Publishers, India. 2018.
4. Laboratory Manual of Cell Biology by R. Majumdar, R. Sisodia. Prestige Publishers, India. 2018.
5. Essential Cell Biology Vol 1: Cell Structure- A Practical Approach by J. Davey and M. Lord. Oxford University Press, UK. 2003.
6. Essential Cell Biology Vol 2: Cell Function- A Practical Approach by J. Davey and M. Lord. Oxford University Press, UK. 2003.

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