GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Biotechnology
Subject Code: BE04004041
Subject Name: Cell Biology

w. e. f. Academic Year:	2024-2025
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Microbiology, Biochemistry
Rationale:	Cell biology studies the cell as the fundamental unit of life, explaining how its structures and processes underlie all living functions. It provides insight into growth, reproduction, and disease by examining cellular components and their interactions. By understanding cells, we unlock mechanisms of health and illness, enabling advances in medicine and biotechnology. This field is essential for connecting molecular processes to organism-level biology

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Understand the cell theory and cellular compartmentalization	15
CO-2	Distinguish the structure and function of the cell organelles and membrane	15
CO-3	Compare and contrast the events of cell cycle and its regulation	25
CO-4	Summarize the definition, sources and applications of stem cells	25
CO-5	Relate the importance of cell cycle on cancer development	20

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	SL	Total no of hours per semester		ESE (E)	PA / CA (M)	PA/ CA (I)	TW/ SL (I)	ESE (V)	
45	0	30	15	90	3	70	30	20	30	50	200

- **Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.**

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, PA = Progressive Assessment, ESE = End-Semester Examination

Content:

Sr. No.	Content	Total Hrs
1	**Introduction to the Cell:** Discovery of cells, cell theory; unity and diversity of cells, cells under the microscope, different classes of cells; prokaryotic cell, eukaryotic cell, structure and function of intracellular organelles, endomembrane system.	15
2	**Cell Membranes:** The structure of cell membranes, membrane lipids, phospholipid bilayer, fluid mosaic model of membrane structure, membrane proteins, integral membrane proteins, peripheral membrane proteins, transmembrane proteins, transport across cell membranes, permeability of phospholipid bilayers, channel and carrier proteins, passive transport, active transport, role of cell membrane in maintaining homeostasis.	15
3	**Cell Regulation:** Cell cycle, mitosis, meiosis, cell cycle checkpoint, molecular mechanics of cell cycle, role of cyclin-dependent kinases in controlling the cell cycle, general principles of cell signaling, types of extracellular signal molecules, types of cell surface receptors, same signal molecule different responses, intracellular receptors, intracellular signaling proteins as molecular switches, signaling by protein phosphorylation and GTP-binding proteins.	15
	TOTAL	**45**

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**20**	**20**	**10**	**10**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Andreas D. Baxevanis, Gary D. Bader, David S. Wishart, Bioinformatics, Wiley, 2019, 4th Edition
2. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2019, 5th Edition
3. John M. Archibald, Genomics: A Very Short Introduction, OUP Oxford, 2018, Illustrated Edition

4. Bioinformatics Lab Manual

List of Experiments / Practical Demonstrations

1. Observation of plant and animal cell morphology under compound microscope. Identify cell structure differences.
2. Study of mitosis using onion root tip. Determine mitotic index and phase duration.
3. Membrane permeability assay using RBC hemolysis. Analyze osmotic balance and tonicity.
4. Vital staining of live vs dead cells using Trypan blue. Correlate cell viability with staining intensity.
5. Study of plasmolysis and DE plasmolysis in plant cells. Observe reversible membrane dynamics.
6. Study of endocytosis and phagocytosis in amoeba. Visualize active transport mechanisms.

Major Equipment

1. Compound and phase contrast microscopes
2. Haemocytometer
3. Centrifuge
4. Staining kits and slides

Open-Source Software / Learning Websites

1. Cell Image Library
2. HHMI Bio interactive videos
3. NPTEL Cell Biology

List of suggested activities for Problem Based Learning:

1. Preparation of cell models (3D or digital).
2. Short video presentation on cell organelles.
3. Case study: Membrane transport defects.

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