

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BIO-TECHNOLOGY(04)

CELL BIOLOGY AND INDUSTRIAL BIOTECHNOLOGY

SUBJECT CODE: 2140405

B.E. 4<sup>th</sup> SEMESTER

**Type of course:** B.E. (Biotechnology)

**Prerequisite:** Basic Concepts of Biology

**Rationale:** It is one of the basic subjects of Biotechnology. It involves various aspects of internal structure of prokaryotic and eukaryotic cells, various processes carried out by them and exploitation of such organisms for industrial purposes.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks					Total Marks	
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M) PA ALA		ESE (V) ESE OEP		PA (I)		
4	0	3	7	70	20	10	20	10	20	150

### Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>UNIT I: Introduction to Cells</b> Introduction to Akaryotic, Prokaryotic and Eukaryotic Cells. Structure of Prokaryotic and Eukaryotic Cells. Origin and evolution of cell	5 hrs	10
2	<b>UNIT II : Cell Biology of Prokaryotes</b> Cellular components of prokaryotic organisms – Cell wall, Cell membrane, Outer Membrane, Cytoplasm, Gas vesicle, Endospore, Plasmid, Nucleoid, Mesosome, Ribosome, Flagella, Slime layer/Capsule - structure, function and integration.	10 hrs	15
3.	<b>UNIT III: Cell Biology of Eukaryotes</b> Cellular components of eukaryotic organisms - Cell Wall, Cell membrane, Cytoplasm, Endoplasmic Reticulum, Ribosome, Lysosome, Golgi Apparatus, Microbodies, Mitochondria, Plastids, Nucleus, Chromosome, Cytoskeleton, Centrioles and Basal bodies , structure, function and integration.	15 hrs	20
4.	<b>Unit IV : Cell Processes:</b> Cell Cycle, Phases of Cell Cycle, Mitosis and Meosis, Functional Importance of each Phase, Molecular Events during Cell Cycle, Check Points, Cyclins and Protein kinases, MPF (Maturation Promoting Factor), Regulation of Cell Cycle. <b>Signaling Pathways:</b> Molecular mechanisms of Signal transduction, Gated Ion Channels, G proteins, cyclic nucleotide and kinase signaling, phospholipid and Ca <sup>2+</sup> signaling, growth factor and cytokine signaling, MAP kinase cascades, signaling via regulated proteolysis	15 hrs	25%
5.	<b>Unit V : Fermentation</b> <b>Biochemistry of fermentation and energy metabolisms.</b> Basic idea on fermentation process, submerged, stationary, solid and semisolid – with their merits and demerits. Isolation, purification and microbial strain	19 hrs	30%

<p>improvement for increased production of the industrial products.</p> <p><b>Types of fermentation Media.</b> Criteria for good medium, medium requirements for fermentation processes, oxygen requirements, medium formulation for optimal growth and product formation, examples of simple and complex media.</p> <p><b>Principle types of fermentation processes-</b> Production of organic acids – citric acid, Production of amino acid – glutamic acid Production of Solvent- Ethyl Alcohol Production of antibiotic – Cephalosporin Production of industrial enzymes Importance of Single cell Protein and its Production.</p>		
--	--	--

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
45	15	30	0	0

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. Molecular Biology of the Cell, by [Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter](#), 5<sup>th</sup> Edition, Publisher : Garland Science
2. Genes VIII by Benjamin Lewin, Publisher: Benjamin Cummings; United States ed edition
3. Cell and Molecular Biology by De Roberties, Publisher: Lippincott Williams and Wilkins, 1<sup>st</sup> Edition
4. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P.S.Verma and V. K. Agarwal, Publisher: Chand (S.) & Co Ltd ,India, 1<sup>st</sup> Edition
5. Industrial Microbiology by L. E. Casida, Publisher: John Wiley & Sons Inc; 1<sup>st</sup> edition.
6. Principles of Fermentation Technology, by Whitaker, Peter F Stanbury, S. Hall and A. Whitaker, Publisher: Butterworth-Heinemann; 2<sup>nd</sup> edition

**Course Outcome:** After learning the course the students should be able:

1. Develop a fundamental understanding between prokaryotic and eukaryotic cells.
2. Compare prokaryotic and eukaryotic cells based on structure and function of their cellular components.
3. Present an overview of industrial fermentation process.
4. Evaluate different biosignalling pathways and various cell processes

### List of Experiments

Introduction of laboratory equipment.

- (a) Cleaning and sterilization of glasswares.
  - (b) Disposal of laboratory wastes and cultures
1. Methods of sterilization.

2. Preparation of culture media
3. Simple staining
4. Differential staining
5. Culture of bacteria on solid medium
6. Culture of bacteria on liquid medium (broth culture)
7. Determination of bacterial growth by turbid metric method.
8. Antibiotic sensitivity test.
9. Pure culture techniques – Streak, spread, pores plate methods.
10. Primary screening for amylase, protease and caiseinase producing potent microbial strain
11. Fermentation of alcohol and citric acid. .

### **Open Ended Problems:**

Students are free to select any project related to Cell Biology or Industrial Biotechnology based on its application in the field of Biology. Some of the suggested projects are:

- Isolation of industrially important strains of microorganism from various sources.
- Fermentative production of Vitamins/Antibiotics.
- Find the microbial population of any food samples.
- Cultivation, identification and preservation of various fungal cultures.

### **Major Equipment:**

- Laminar Air flow
- Auto clave
- Spectrophotometer/Colorimeter
- Centrifuge
- Rotatory Shaker
- Microscope

### **List of Open Source Software/learning website:**

Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books. Students can develop their own flowsheets for demonstration of various fermentation processes.

### **Active Learning Assignments:**

Preparation of power-point slides, which include videos, animations, Pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Process Heat Transfer and fluid flow operation is covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be sent to GTU.