GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Science (Industrial Biotechnology)

Level: PG

Course / Subject Code: IB01001011

Course / Subject Name : Microbial Biochemistry

1. Learning Outcomes

Learning Outcome Component	Learning Outcome (Learner will be able to)
Theoretical and practical understanding of microbial biochemistry	• Describe microbial genome. • Compare prokaryotic and eukaryotic genomes.
Give an insight in applicability of microbial biochemistry in different fields of industry	• Discuss microbial signal transduction and homeostasis. • Describe mutation, mutagenesis, mutants and mutation analysis. • Discuss the molecular basis of mutations.
Effective Communication	• Communicate concepts and ideas effectively.
Professional & Ethical Behaviour	• Transparency, honesty and ethical reasoning in handling mutants and biomolecules.

LO – PO Mapping: Correlation Levels:

1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), "-"= no correlation

Sub Code: 1310101	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1: Theoretical and practical understanding of microbial biochemistry	2	2	3	1	2	2	1
LO2: Give an insight in applicability of microbial biochemistry in different fields of industry	3	3	2	3	2	3	1
LO3: Effective Communication	3	3	3	2	3	2	1
LO4: Professional & Ethical Behaviour	2	2	2	3	2	2	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	**Microbial diversity**	5	10

	Structural/physiological/biochemical differences between different basic microbial cell types, Biochemical/microscopic/molecular methods used to differentiate between archae, eubacteria and eukaryotes, Estimation of microbial biodiversity, Diversity in some ecosystems.		
2	**Introduction to biomoleculesI** Sugars - mono, di, and polysaccharides with specific reference to glycogen, amylose and cellulose, glycosylation of other biomolecules - glycoproteins and glycolipids; amino acids – structure and functional group properties, peptides and covalent structure of proteins, nucleosides, nucleotides, nucleic acids - structure, a historical perspective leading up to proposition of DNA double helical structure.	5	10
3	**Microbial nutrition** Microbial nutrition, Different types of culture medium, C/N/P balance and making of culture medium.	3	5
4	**Cell membranes** Outer membrane of Gram –ve bacteria and control of its synthesis (potential targets for drug design), Different types of transport within the cell.	4	6
5	**Bio-energetic principles** Oxidation-reduction reactions, Electron carriers and cellular metabolism, High energy compounds and their role in microbial fermentation, Enzymes as catalysts.	4	6
6	**Major catabolic pathways** Glycolysis, Pentose Phosphate Pathway, Citric Acid cycle, Oxidative Phosphorylation; Cellular metabolites and interconnectivity in biochemical pathways, Respiration and electron transport.	5	6
7	**Metabolic diversity** Energy from oxidation of inorganic electron donors, Methanotrophy and methylotrophy, Nitrate and Sulfate reduction, Acetogenesis, Methanogenesis, Fermentations-energetics and redox constraints, Anaerobic respiration.	5	7
8	**Microbial photosynthesis** Chlorophylls and other pigments involved in microbial photosynthesis, Anoxygenic and oxygenic photosynthesis,	4	5

	Autotrophic CO2 Fixation: Calvin cycle, Reverse Citric Acid cycle, Hydroxy-propionate cycle.		
9	**Microbial genetics** Mutations and their chemical basis, Mutagens and their use in Biotechnology, Modes of recombination, Comparative prokaryotic genomics.	4	10
10	**Applications of genetic engineering** Vectors and Expression systems (only bacteria and fungi), Case studies in microbial derived products	6	5
11	**Practicals** 1. Identify Bacteria, Yeasts, Filamentous fungi, Actinomycetes by Microscopy, Cultivate Bacteria and Other Microbes in Liquid Culture and Solid Media 2. Isolation of Pure Cultures by Streaking 3. Isolation of Auxotropic Mutants of Bacteria, Replica Plating 4. Antimicrobial Sensitivity and Demonstration of Drug Resistance 5. Estimation of Lipids 6. Estimation of Carbohydrates 7. Estimation of Proteins (Bradford, Lowry's Method) 8. Estimation of alcohol, Acetic Acid by Gas chromatography 9. Isolation of Carotenoids (and lipids) and Analysis by Thin Layer Chromatography (TLC) 10. Isolation of Secondary Metabolites and analysis by TLC 11. Maintenance of Stock Cultures: slants, stabs, glycerol stocks	—	(30 marks)

4. Pedagogy:

- ICT enabled Classroom teaching
- Practical / live assignment
- Interactive classroom discussions

5. Evaluation:
Students shall be evaluated on the following components:

	Internal Evaluation	**(Internal Assessment – 20 Marks)**
A	• Continuous Evaluation Component	10 marks
	• Class Presence	5 marks

	• Record maintenance	5 marks
B	**Mid-Semester Examination**	**(Internal assessment-30 Marks)**
C	**End-Semester Examination**	**(External assessment-70 Marks)**

6. Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	M.T. Madigan and J.M. Martinko	Brock Biology of Microorganisms	Pearson Prentice-Hall	Latest edition
2	Voet, D., & Voet, J. G.	Biochemistry	J. Wiley & Sons	Latest Edition

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

7. List of Journals/Periodicals/Magazines/Newspapers / Web resources, etc

- https://academic.oup.com/jb?gclid=CjwKCAiA4KaRBhBdEiwAZi1zzogwrvWMANjPmTIntS0-B9_T04DqDmdeWZftwBxbwGldZaO-L6eDcRoCgGwQAvD_BwE
- https://www.springer.com/journal/10438/

Course Outcomes:

On completion of this course, students should be able to:

• Discuss microbial signal transduction and homeostasis;

• Describe microbial genome;

• Describe mutation, mutagenesis, mutants and mutation analysis;

• Discuss molecular basis of mutations;

• Compare prokaryotic and eukaryotic genomes.