GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 7
Subject Name: Microbial Biochemistry
Subject Code: 1370401

Prerequisite: Candidates enrolling in the Integrated MSc in Industrial Biotechnology with an elective in Microbial Biochemistry should have a solid foundation in core biological and chemical sciences. This includes prior coursework or knowledge in microbiology, biochemistry, molecular biology, and organic chemistry. Understanding microbial physiology, metabolic pathways, enzyme kinetics, and the structure-function relationships of biomolecules is essential. Additionally, practical laboratory experience in techniques such as spectrophotometry, chromatography, and electrophoresis will be beneficial. This background ensures that students are well-prepared to engage with advanced topics in microbial metabolism, enzymology, and the biochemical applications of microorganisms in industrial processes.

Rationale: Incorporating an elective in Microbial Biochemistry into the MSc Industrial Biotechnology curriculum is essential for providing students with a comprehensive understanding of the biochemical processes that underpin microbial life. This knowledge is crucial for manipulating microorganisms in industrial applications, such as fermentation technology, enzyme production, and bioremediation. By delving into microbial metabolic pathways and enzyme mechanisms, students can develop strategies to enhance microbial performance and productivity in biotechnological processes. This integration not only bridges the gap between theoretical biochemistry and practical industrial applications but also equips graduates with the expertise to innovate and optimize microbial systems for sustainable industrial solutions.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	8	4	70	30	30	20	150

Course Content:

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

	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.		
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, Autotrophic CO2 Fixation: Calvin cycle, Reverse Citric Acid cycle, Hydroxy-propionate cycle.	**4**	**5**
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**

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

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Describe microbial genome. Compare prokaryotic and eukaryotic genomes.	UN
2	Discuss microbial signal transduction and homeostasis. Describe mutation, mutagenesis, mutants and mutation analysis. Discuss the molecular basis of mutations.	AN
3	Communicate concepts and ideas effectively.	EL
4	Transparency, honesty and ethical reasoning in handling mutants and biomolecules.	RM
5	Describe microbial genome. Compare prokaryotic and eukaryotic genomes.	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

List of Experiments:

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

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