Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-4 (B.Sc.)

Subject: Prokaryotic metabolism - BSCMB14312

Type of course: Major

Prerequisite: Understand cell structure, biochemistry, enzyme function, metabolic pathways, growth factors, nutritional types, genetics, and laboratory techniques for prokaryotic metabolism.

Rationale: Foundational knowledge in microbiology is essential for comprehending prokaryotic metabolism, influencing applications in health, industry, and environmental science.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				SEE		CCE			
CI	T	P	C	Theory	Practical	MSE	LWA/V	ALA	
3	0	2	4	75	25	30	20	50	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; MSE- Mid Semester Examination; LWA - Lab Work Assessment; V – Viva voice; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

GYANMANJARI INNOVATIVE UNIVERSITY BHAVNAGAR

Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Chapter-1: Introduction to enzymes & Bioenergetics** **Enzymes**: • Introduction to Enzymes, most enzymes are protein, how enzymes are work. • Enzyme kinetics as an approach to understanding mechanism. • Types of enzymes inhibitions: Reversible and irreversible. • Types of regulatory mechanisms: Feedback inhibition, Energy linked control, Zymogen activation, covalent modification and Allosterism. • Multisubstrate reactions.	15	25
2	**Chapter-2: Heterotrophic mode of metabolism** • Types of Chemoheterotrophic growth: Catabolism of glucose: EMP, ED & PP pathway. • Fate of pyruvate, Gluconeogenesis, Tricarboxylic acid (TCA) cycle and its amphibolic nature. • Catabolism of fatty acids and proteins: β-oxidation of fatty acids. • Catabolism of amino acid: Deamination, decarboxylation, transamination, Stickland reaction. • The Fueling Reactions of anaerobic chemotrophs: Anaerobic respiration, Fermentation. **Bioenergetics:** • Substrate level phosphorylation. o Electron transport chain: Organization and Components of electron transport chain in bacteria and its role.	10	25

3	**Chapter-3: Bacterial Metabolism** • Concepts and types of chemolithotrophy with examples. • Types of phototrophy, oxygenic versus anoxygenic photosynthesis. • Autotrophy and CO_2 fixation. • Reductive TCA cycle. • Reverse ETC and its significance. • Generation of ATP and reducing power in Chemoautotrophs.	10	25
4	**Chapter-4: Anabolism the use of energy in biosynthesis** • Methods of studying biosynthesis. • Principle governing biosynthesis. • Precursor metabolites. • Glyoxylate pathway and its significance. • Nitrogen Assimilation. • Sulfur Assimilation. • Anaplerotic reactions. • Biosynthesis of saturated and unsaturated fatty acids. • Nucleotide biosynthesis.	10	25

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Define enzyme inhibition** Faculty will provide starting point of enzyme inhibition types, student will complete the chain of that inhibition and upload it to GMIU web portal	10
2	**Solve the mystery of metabolism** Student will count the total generating ATP from different metabolic pathways and prepare a diagram on this and upload it to GMIU web Portal.	10
3	**Variation of chemolithotrophs** Student will analyze and prepare table on different types of chemolithotrophy and their nutrition source, upload it to GMIU web Portal.	10
4	**Hunting of TCA Cycle** Students will indentify the products of TCA cycle in different metabolism/anabolism and prepare note on this and upload the photo on to the GMIU web Portal.	10

5	**Attendance**	10
Total		**50**

Suggested Specification table with Marks (Theory):75

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	30%	40%	20%	10%	-	-

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.

Course Outcome:

After learning the course the students should be able to:	
CO1	Interpret the principles of bioenergetics in prokaryotic metabolism, including ATP production and energy transfer mechanisms.
CO2	Analyze major metabolic pathways in prokaryotes, including glycolysis and fermentation.
CO3	Acquire knowledge of bacterial physiology in chemolithotrophy and phototrophy oragnisms.
CO4	Understand the principles and methods Anabolism the use of energy in biosynthesis.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1	To understand binding change model for rotational catalysis of ATP.	1	2
2	Separation of amino acids by paper chromatography.	2	2

3	Starch utilization test and qualitative check of amylase activity.	2	4
4	Separation of amino acids by thin layer chromatography.	3	4
5	To identify and characterize the different types of carbohydrates by commonly used qualitative methods: Molisch's Test, Benedict's Test, Barfoed's test, Seliwanoff's Test, Bial's Test, Iodine Test.	4	4
6	To determine the concentration of carbohydrates by commonly used methods 3, 5- Dinitrosalicylic Acid (DNSA) Method.	4	4
7	To determine the concentration of a protein by three commonly used methods:. Folin – Ciocalteau (Lowry) Assay.	4	4
8	To identify and characterize the different types of proteins by commonly used qualitative methods Biuret Test, Ninhydrin Test, Xanthoproteic Test, Sulphur Test, Neumann's Test.	4	4
9	To identify and characterize the different types of lipid by commonly used qualitative methods: Solubility Test, Saponification Test, Iodine Test.	4	2
Total			**30**

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Prinzipien Der Biochemie textbook by Albert L. Lehninger, David L. Nelson, and Michael M. Cox.

[2] Prescott L, Harley J P, and Klein D A, (2008). Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.
[3] Lehninger A.L -2012, Principles of Biochemistry,Freeman, W.H.& ComConn E.E and Stumps P.K(1972), Outlines of biochemistry, 3rd edition,John Wiley & Sons.
[4] Stanier R Y, Adelberg E A and Ingrahm J L, (1991), General Microbiology, 5th edn. Mac Millan Press Inc.
[5] Practical Microbiology: Patel RJ, Aditya Publications.
[6] Practical Microbiology: Dubey RC and Maheshwari DK, S Chand Publication.