Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science College
Semester-7 (B.Sc.)

Subject: Microbial Physiology - BSCMB17401

Type of course: Major

Prerequisite: Basic understanding of microbiology, biochemistry, and molecular biology including metabolism and gene expression.

Rationale: Provides foundational knowledge of microbial growth, metabolism, and gene regulation for advanced microbiological applications.

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; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; 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.

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Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Growth of Bacteria and Metabolism** • Growth curve and methods for measurement of growth. • Synchronous and asynchronous growth, batch, fed batch and continuous culture of bacteria. • Cell division cycle: Cell division cycle in yeasts, cdks and cyclins as regulators. • Dormancy and stages of bacterial spore formation. • Chemotaxis. • Secondary metabolites and secondary metabolism: Antibiotics, siderophores and bacteriocins. • Microbial toxins. • Multiple drug resistance, biochemical mechanisms of drug resistance. • Plasmids and transposons mediated drug resistance.	10	25
2	**Bioenergetics** • Microbial photosynthesis: Oxygenic and anoxygenic photosynthesis. • Regulatory systems during aerobic-anaerobic shifts and oxidative stress. • Metabolism of substrates (other than glucose): lactose, maltose, mannitol. • ETC in bacteria and eukaryotes; ATP synthesis and release, atp operon. • Metabolite transport: (i) facilitated diffusion: GlpF, aqpZ (ii) Mechanosensitive channels (iii) ABC transporters (iv) Chemiosmotic-driven transport (v) Ion motive pump: Kdp ATPase (vi) His permease (vii) phosphotransferase system (PTS).	10	25

3	**Regulation of Prokaryotic Gene Expression - I** • Regulation of carbohydrate metabolism by Cra regulation in E. coli. • Translational attenuation: Regulation of pyrC in pyrimidine biosynthesis. • Flagellar phase variation: Regulation of fliC and fljB in Salmonella sp. • Greater stress resistance and enhanced nutrition scavenging capabilities in Bacillus sp.: CsrA/CsrB regulation. • ntr and pho system in response to nitrogen fixation and phosphorus starvation. • ArcAB and fnr system.	10	25
4	**Regulation of Prokaryotic Gene Expression - II** • Cell signaling mechanisms. • Operons: ara, his, gal operons. • Global regulation: Two component signal transduction system. • Quorum sensing and bioluminescence: lux operon and its regulation. • Osmotic control of gene expression and Heat shock response. • Stringent response. • Multicellular organization of selected microbes.	10	25

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Mini-Research Project** Faculty will provide topics and students will develop a short research study on microbial metabolism or regulatory mechanisms. Students will upload report on GMIU web portal.	10
2	**Construction of Pathway** Faculty will provide topics and students will Recreate metabolic and regulatory pathways from memory and explain their significance. Students will upload pathway on GMIU web portal.	10
3	**Review of Article** The faculty will provide topics and students will read a research/review article and summarize key findings in their own words and upload a pathway on GMIU web portal.	10
4	**Diagram Preparation** The faculty will provide topics and students will draw and label processes like photosynthesis, fermentation, or transport systems from memory upload pathway on 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	20%	20%	30%	10%	10%	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	Analyze bacterial growth dynamics, cell cycle control, metabolic adaptation, and molecular mechanisms of antimicrobial resistance.
CO2	Evaluate microbial bioenergetic pathways, including photosynthesis, respiration, fermentation, and transport systems.
CO3	Interpret regulatory networks of prokaryotic gene expression involving operons, signaling, and metabolic control.
CO4	Assess global gene regulation mechanisms, including quorum sensing, stress responses, and signal transduction.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1	Standard growth curve of *Escherichia coli.*	1	4
2	Diauxic growth curve of *Escherichia coli.*	1	4
3	Estimation of cellulase from fungi.	2	4
4	Study of pectin lyase activity from fungi.	2	2
5	Growth curve by protein estimation.	3	2
6	Effect of temperature on growth of E. coli	3	2
7	Effect of pH on growth of E. coli	2	4
8	Effect of carbon and nitrogen sources on growth of E. coli	3	4
9	Effect of salt on growth of E. coli	4	2
10	Effect of heavy metal on growth of E. coli	4	2
Total			**30**

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any 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 the laboratory.

Reference Books:

1. Lehninger, A. L. (2000). Principles of biochemistry (3rd ed.). Worth Publishers.
2. Berg, J. M., Tymoczko, J. L., & Stryer, L. (2001). Biochemistry (5th ed.). W. H. Freeman.
3. Caldwell, D. R. (1995). Microbial physiology and metabolism. Brown Publishers.
4. Moat, A. G., & Foster, J. W. (1999). Microbial physiology. Wiley-Liss.
5. Brun, Y. N., & Shimkets, L. J. (Eds.). (2000). Prokaryotic development. ASM Press.
6. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., & Painter, P. R. (1986). General microbiology. MacMillan Education Ltd.
7. Reddy, S.R., and Reddy, S.M. (2005). Microbial Physiology. Scientific Publishers India
8. Madigan, M.T., and Martinko, J.M. (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
9. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
10. Gottschalk, G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.