Semester	**V**
Course	**Major 2**
Paper Title	Microbial Physiology
Paper Code	C3BT230522T/P
No of Credits	4 (3+1)
Theory /Practical /Composite	Composite
Minimum No. of preparatory hours per week a student has to devote	4
Number of Modules	2
Syllabus	**MODULE A [25 Marks]** **UNIT I: Effect of the environment on microbial growth:** Temperature - temperature ranges for microbial growth, classification based on temperature ranges and adaptations, pH-classification based on pH ranges and adaptations, solutes and water activity, oxygen concentration, radiation and pressure; diauxic growth curve. **UNIT II: Microbial stress response:** Mechanisms of sensing stresses: alternate σ factors, regulation of translation of RpoS (the general stress response activator); small molecules (The stringent response), tmRNA; global control networks: Bacterial Two-Component Regulatory Systems (EnvZ/OmpR system), Integrated Biochemical and Genetic Control networks of nitrogen assimilation, phosphate uptake and pho regulon, osmotic stress and osmoregulation (Trk, Kdp, and Kup systems in *E. coli*), oxidative stress response, heat shock response, pH stress and acid tolerance, bacterial efflux pumps; Transcription Controls in *Archaea*. **UNIT III: Transport processes:** Metabolite Transport, Diffusion: Passive and facilitated, primary active and secondary active transport, group translocation (phosphotransferase system), symport (sodium-glucose co-transport), antiport (sodium-potassium antiport) and uniport (transport of glucose and lactose), Histidine permease system; electrogenic and electro-neutral transport (energetics), transport of iron; yeast ABC-transporters. **UNIT IV: Nitrogen metabolism:** Nitrogen cycle (nitrification; denitrification; biological nitrogen fixation; ammonification and ammonia fluxes; Anammox); ammonia assimilation; assimilative and dissimilative nitrate reduction. **MODULE B [20 Marks]** **UNIT V: Growth physiology:** Reproductive strategies in bacterial cells; MreB and cell morphology; bacterial cell cycle (including chromosome replication & partitioning – MreB model, cytokinesis – Fts proteins and Divisome complex); peptidoglycan biosynthesis.

	UNIT VI: Phototrophic Metabolism: Photosynthesis and chlorophylls; anoxygenic photosynthesis; oxygenic photosynthesis; autotrophic pathways. **UNIT VII: Chemolithotrophy:** Inorganic compounds as electron donors; oxidation of reduced sulfur compounds; hydrogen oxidation; iron oxidation. **UNIT VIII: Fermentation:** Energetic and redox considerations; lactic and mixed acid fermentation; Clostridial and propionate fermentation; syntrophy. **PRACTICAL** 1. Study of Growth Kinetics of *E. coli* by turbidometric method and plotting of Growth Curve. 2. Effect of temperature and salt concentration on growth of *E. coli.* 3. Determination of antibiotic sensitivity/resistance of bacteria by Kirby-Bauer Disc-Diffusion method. 4. Determination of MIC/MBC of antibiotics by Broth-Dilution Method. 5. Isolation of nitrogen-fixing bacteria from a soil sample.
Learning Outcomes	1. Through this course, the students will study the effect of various environmental parameters on microbial growth and learn about the different molecular signaling mechanisms involved in microbial stress response. 2. The different modes of metabolite transport processes and their physiological aspects in microbial physiology will be discussed in this paper. 3. Different aspects of nitrogen metabolism in microbes will be explained in this course. 4. Through this paper, students will be explained the details of growth physiology and the recent theories explaining it. 5. Different aspects of phototrophy, chemolithotrophy and fermentation in microbes will also be elaborated in this paper. 6. To provide hands-on experience in conducting bacterial Growth Kinetics experiment by turbidometric method, and plotting of Growth Curve. 7. To study the effect of growth parameters like temperature and salt concentration on bacterial growth. 8. To determine antibiotic sensitivity/resistance of bacteria by Kirby-Bauer Disc-Diffusion method. 9. To provide hands-on experience on isolation of nitrogen-fixing bacteria from a soil sample.

Reading / Reference List	**1) Theory text/references** **Module A** 1. Alberts B, *et al*. Molecular Biology of the Cell. 2. Karp G. Cell and Molecular Biology – Concepts and Experiments. 3. Weaver. Molecular Biology. 4. Madigan MT, Martinko JM, Bender KS, Buckley DH and Stahl DA. (2017). Brock Biology of Microorganisms.14th edition. Pearson Education, Limited. 5. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons. 6. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India. 7. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education. 9. Relevant Scientific Literature. **Module B** 1. Bauman RW. (2011). Microbiology: With Diseases by Taxonomy. 3rd edition. Pearson / Benjamin Cummings. 2. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag 3. Madigan MT, Martinko JM, Bender KS, Buckley DH and Stahl DA. (2017). Brock Biology of Microorganisms.14th edition. Pearson Education, Limited. 4. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons. 5. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India. 6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press. 7. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education. 8. Relevant Scientific Literature. **2) Practical text/references** 1. Experiments in Microbiology, Plant Pathology, Tissue culture and Microbial Biotechnology – K. R. Aneja. 6th Edition (2022). New Age International Private Limited. 2. Laboratory Manual of Microbiology and Biotechnology – K. R. Aneja. 2nd Edition. (2017). MedTech Publishers. 3. Microbiology: A Laboratory Manual – Cappuccino and Sherman. 10th Edition. (2013). Pearson Benjamin Cummings Publishers. 4. Practical Microbiology – Dr. R.C. Dubey, D K Maheshwari (2023 Ed). S Chand and Company Publishing.

Evaluation	**Theory** CIA- 10 Assignment – 02 Attendance - 03 Semester Exam- 45	**Practical** CA- 30 Attendance - 02 Semester Exam- 08
Paper Structure for Theory Semester Exam	**Module A (25 marks)** • 5 compulsory Multiple Choice Type questions; each carrying 1 mark: 5 × 1 mark = 5 marks • Objective Question – Any 5 out of 7 questions; each of 2 marks, with subparts (no sub-part will be less than 1 mark): 5 × 2 marks = 10 marks • Any 1 out of 2 questions; each of 10 marks, with subparts (no sub-part will be more than 5 marks, and less than 1 mark): 1 × 10 marks = 10 marks **Module B (20 Marks)** • 1 Compulsory Multiple Choice Type Question – Any 5 out of 7 questions; each of 2 marks: 5 × 2 marks = 10 marks • Any 1 out of 2 questions; each of 10 marks, with subparts (no sub-part will be more than 5 marks, and less than 1 mark): 1 × 10 marks = 10 marks	