SEMESTER III

COURSE 1 BASIC MICROBIOLOGY

Theory | Credits: 3 | 3 hours per week | Total teaching hours: 45

I Learning Objectives

1. To introduce the history, scope, and importance of microbiology.

2. To provide knowledge of microbial diversity, including bacteria, archaea, fungi, algae, protozoa, helminths, and viruses.

3. To explain microbial cell structures and their functional significance.

4. To describe microbial growth, nutrition, and environmental influences.

5. To establish a foundation for advanced microbiology courses.

II Course Outcomes

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

CO1. Recall the history and contributions of pioneers in microbiology.

CO2. Differentiate between prokaryotic and eukaryotic microorganisms.

CO3. Explain structural and physiological features of microbial groups.

CO4. Classify microorganisms based on Bergey's Manual, morphology, and host specificity.

CO5. Interpret microbial growth patterns under varying nutritional and environmental conditions.

Activity Implementation

The activities listed under each unit provide options for classroom and independent learning. The instructor shall select and schedule appropriate activities, communicate the expected submission and assessment criteria in advance, and provide feedback. Activity time shall be planned within the course delivery and independent study schedule; the theory allocation remains nine hours per unit.

III Syllabus of Theory

Unit 1 Fundamentals of Microbiology

Teaching hours: 9 | Related course outcomes: CO1, CO2 and CO4

1.1 History and major contributions – Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Ignaz Semmelweis, Alexander Fleming, Ivanowsky, Beijerinck, Winogradsky.

1.2 Scope, branches, applications and importance of microbiology in health, agriculture, food, industry and environment.

1.3 Classification of microorganisms – Whittaker's Five Kingdoms, Carl Woese's Three Domains.

1.4 Origin of microbial life on Earth – Timeline of microbial evolution, Endosymbiosis theory (role of cyanobacteria), differences between prokaryotic and eukaryotic cells.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Prepare a comparative chart of the contributions of any five listed pioneers. Link each contribution to its significance in microbiology.	A referenced chart and a 300-word explanation.
Seminar	Present the contribution of one pioneer, explaining the question investigated, approach and significance.	A 5–7 minute presentation and responses to questions.
Quiz	Answer questions on pioneers, branches, Five Kingdoms, Three Domains and differences between prokaryotic and eukaryotic cells.	A 20-mark individual quiz.
Project	Develop an annotated timeline of major milestones in microbiology and microbial evolution using reference sources.	A timeline poster with source list and a brief explanation.
Peer teaching	Teach a small group to compare prokaryotic and eukaryotic cells using a labelled diagram.	A 5-minute lesson, comparison sheet and three check questions.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section V to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 2 Microbial Diversity – Prokaryotes

Teaching hours: 9 | Related course outcomes: CO3 and CO4

2.1 General features of Bacteria and Archaea.

2.2 Bacterial cell structure: cell wall, glycocalyx/capsule, flagella, pili, fimbriae, nucleoid, plasmids, ribosomes, cytoplasmic membrane, mesosomes, inclusion bodies, endospore.

2.3 Gram-positive and Gram-negative bacteria – structural differences and significance.

2.4 Bergey's Manual of Systematic Bacteriology – basic outline of bacterial classification. Economic importance of bacteria.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare Bacteria and Archaea, and draw labelled Gram-positive and Gram-negative cell envelopes. Relate the listed structures to their functions.	A comparison table and two annotated diagrams.
Seminar	Discuss the economic importance of bacteria in any two areas such as agriculture, food or industry.	A 5–7 minute presentation with referenced examples.

Activity	Task	Expected submission
Quiz	Identify bacterial structures from diagrams and answer questions on their functions, cell-envelope differences and classification.	A 20-mark individual quiz.
Project	Create a model or digital illustration of a bacterial cell with a structure–function key.	A model or illustration, key and short oral explanation.
Peer teaching	Teach the basic outline of bacterial classification using instructor-provided examples from Bergey's Manual.	A classification worksheet and a 5-minute teaching session.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section V to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 3 Microbial Diversity – Eukaryotes

Teaching hours: 9 | Related course outcomes: CO3 and CO4

3.1 General features of fungi – morphology, reproduction, significance.

3.2 General features of microalgae – classification, ecological roles, photosynthetic pigments.

3.3 General features of protozoa – morphology, modes of nutrition, reproduction, parasitic protozoa overview.

3.4 Economic importance of algae and fungi.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare fungi, microalgae and protozoa in terms of morphology, nutrition, reproduction and significance.	A referenced comparative table with labelled examples.
Seminar	Present the ecological role of microalgae or the economic importance of fungi, using selected examples.	A 5–7 minute presentation and question session.
Quiz	Use supplied images and descriptions to identify microbial groups and answer questions on pigments, nutrition and reproduction.	A 20-mark individual quiz.
Project	Prepare a digital or paper atlas of fungi, microalgae and protozoa using reference images.	An atlas with three examples per group, labels and image credits.
Peer teaching	Explain reproduction or nutrition in one eukaryotic microbial group through diagrams and examples.	A 5-minute lesson and a three-question peer worksheet.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section V to the task. Share the

rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 4 Viruses and Other Acellular Agents

Teaching hours: 9 Related course outcomes: CO3 and CO4

4.1 General characteristics of viruses, bacteriophages, viroids, and prions.

4.2 Structure of typical viruses – bacterial (T4 bacteriophage and Lambda (λ) bacteriophage), plant (Tobacco mosaic virus, TMV), animal viruses (Adenovirus and Influenza virus).

4.3 Host specificity and classification of viruses – plant viruses, animal viruses, bacteriophages; cultivation of viruses.

4.4 Role of viruses as disease-causing agents and as useful tools in biotechnology (gene therapy vectors, vaccine development).

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare viruses, viroids and prions. Include labelled structural diagrams of T4 bacteriophage, TMV and an animal virus listed in the syllabus.	A comparative table and annotated diagrams.
Seminar	Discuss viruses as tools in vaccine development or gene therapy, drawing on reference material.	A 5–7 minute presentation and source list.
Quiz	Identify viral structures and match viruses with host groups; distinguish viruses, viroids and prions.	A 20-mark individual quiz.
Project	Construct a model or infographic of one listed virus, showing its components, host group and significance.	A labelled model or infographic and a brief explanatory note.
Peer teaching	Explain host specificity and outline virus cultivation approaches through a concept map.	A 5-minute lesson, concept map and three check questions.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section V to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 5 Bacterial Growth and Nutrition

Teaching hours: 9 | Related course outcomes: CO3 and CO5

5.1 Nutritional requirements of bacteria: macronutrients, micronutrients, growth factors; nutritional types (autotrophs, heterotrophs, phototrophs, chemotrophs).

5.2 Culture media: defined, complex, selective, differential, enrichment, transport.

5.3 Bacterial growth curve: phases (lag, log, stationary, death) and significance. Generation time, number of generations.

5.4 Factors affecting bacterial growth: temperature, pH, osmotic pressure, oxygen requirement (aerobes, anaerobes, facultatives, microaerophiles).

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Classify culture media by purpose and solve instructor-provided problems on generation time and number of generations.	A media comparison table and worked calculations.
Seminar	Explain how one environmental factor influences bacterial growth, using a graph or a case example.	A 5–7 minute presentation with interpreted evidence.
Quiz	Answer questions on nutritional types, media selection and growth phases; solve short growth calculations.	A 20-mark individual quiz.
Project	Plot instructor-provided growth data, identify phases and compare growth under two environmental conditions. Calculate generation time from suitable data.	A graph or spreadsheet and a 500-word interpretation.
Peer teaching	Teach growth-curve interpretation and demonstrate a generation-time calculation step by step.	A 5-minute lesson, worked example and short peer exercise.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section V to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

IV Co-curricular Activities

1. Seminars: Contributions of microbiologists and presentations on microbial diversity.
2. Assignments: Charts on microbial cell structure and the microbial growth curve.
3. Poster or model making: Prokaryotic versus eukaryotic cells and virus structure.
4. Field visit: A local water body or soil site for microbial awareness.
5. Quiz or debate: “Are viruses living or non-living?”

V Evaluation of Learning Activities

The instructor is required to prepare a dedicated assessment rubric for each activity assigned. The templates below are proposed for use and adaptation; they do not prescribe institutional internal-assessment weightage. For each task, specify the unit, course outcome, expected evidence, deadline, criteria, performance descriptors and maximum marks before the activity begins.VI Reference Books

1. Pelczar, Reid & Chan – Microbiology.
2. Prescott, Harley & Klein – Microbiology.
3. Madigan & Martinko – Brock Biology of Microorganisms.
4. Tortora, Funke & Case – Microbiology: An Introduction.

5. Cappuccino & Sherman – Microbiology: A Laboratory Manual.

SEMESTER-III

COURSE 1: BASIC MICROBIOLOGY

Practical **Credits: 1** **2 hrs/week**

I. **Course Outcomes:** On successful completion of this practical course, student shall be able to:

1. Demonstrate Good Laboratory Practices, biosafety procedures, and proper handling of the compound light microscope and its parts.
2. Perform microscopic observation and identification of microorganisms including bacteria, algae, fungi, protozoa, and interpret electron micrographs of viruses.
3. Operate essential microbiology laboratory equipment like autoclave, hot air oven, and laminar airflow chamber by following correct working principles and aseptic techniques.

II. Laboratory/Field exercises:

1. Microbiology Laboratory: Basic Rules and Requirements
2. Laboratory equipment: Working principles of Autoclave, Hot air oven, Laminar airflow chamber.
3. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.

4. Study of fungal morphology using Lactophenol cotton blue.
5. Study of algal morphology using wet mount.
6. Enumeration of Bacteriophages by Plaque Assay
7. Effect of Environmental temperature on Bacterial Growth.