

MICROB-GE-1**INTRODUCTION AND SCOPE OF MICROBIOLOGY**

**Marks: 100 (Theory = 50 marks
Practicals = 50 marks)**

**Duration: Theory = 30 hours (2 credits)
Practicals = 60 hours(2 credits)**

Course objectives:

The main objective of the course is to give students an overview of three major themes: History and scope of Microbiology, microbial diversity (prokaryotes, eukaryotes, and viruses), and the role of microbes in human lives. Students will gain insights into how microorganisms affect the everyday lives of humans in both beneficial and harmful ways. Students will become familiar with the techniques used in isolation and cultivation of microorganisms, and will learn how to identify microorganisms in the laboratory.

Pre-requisite: None.

Course Learning Outcomes:

Upon successful completion of the course the student :

CO1: Will become familiar with the history of Microbiology, and understand how Microbiology developed as a distinct discipline of science during the golden era of microbiology. Will become familiar with some of the later developments of the 21st century.

CO2: Will acquire an understanding about the placement of microorganisms in the tree of life. Will know about key differences between prokaryotic and eukaryotic organisms. Will also be acquainted with structure of viruses, general characteristics and importance of algae, fungi and protozoa.

CO3: Will understand the importance of microbe-human interactions, becoming aware of microorganisms as agents of human diseases. Will become aware of the important role that microorganisms play in food, agriculture, industry, biofuel and in the clean-up of the environment.

CO4: Will become aware of good microbiological laboratory and safety practices, and be acquainted with the working of basic microbiological equipment routinely used in the laboratory. Will also be acquainted with the aseptic techniques used for culturing bacteria and fungi.

CO5: Will gain hands-on experience in isolation of bacteria and fungi from air and will be acquainted with staining techniques used for observing bacteria, algae and fungi. Will learn the use of compound microscope.

CO6: Will get acquainted with different shapes and arrangement of bacteria. Will be able to identify algae, fungi, protozoa using permanent slides/photographs. Will be able to understand the structure of viruses using electron micrographs.

Contents:

Theory:

30 hours

Unit 1: History of Microbiology: Some key milestones in the field of microbiology: Contributions of Antonie van Leeuwenhoek. Controversy over spontaneous generation. Louis

Pasteur and concept of pasteurization. Robert Koch and germ theory of diseases, and concept of pure culture. Edward Jenner and cowpox immunization. Ivanovsky & Beijerinck and the discovery of viruses. Winogradsky and the development of soil microbiology. Golden era of Microbiology. **8**

Unit 2: Microbial Diversity: Position of microorganisms in the living world. Whittaker's five kingdom classification. Carl Woese's three domain classification. Detailed characteristics of prokaryotic and eukaryotic organisms with examples of *E. coli* (bacterium) and *Saccharomyces* (yeast). Acellular organisms: structure and genome of Tobacco mosaic virus, polio virus and bacteriophage T4. General characteristics, habitat and economic importance of algae, fungi and protozoa. **12**

Unit 3: The impact of microorganisms on humans: Causal organism and transmission of common human diseases: typhoid, tuberculosis, cholera, malaria, gastroenteritis, influenza. Microorganisms and their applications in agriculture: nitrogen fixers and mycorrhiza. Role of microorganisms in the environment: microbial remediation of pollutants. Applications of microorganisms in food and industry: fermented foods and probiotics, biofuel (biogas), antibiotics and enzymes. **10**

Practicals: **60 hours**

Unit 4: Microbiological laboratory practices, and equipment: Good Microbiology laboratory practices and general safety measures while working with microbes. Physical and chemical hazards and immediate first aid. Principle, working and applications of instruments: autoclave, hot air oven, biosafety hood, incubator and light and compound microscope. Demonstration and performance of aseptic technique for culturing of bacteria and fungi. **24**

Unit 5: Cultivation, isolation and staining of cellular microorganisms: Study of aero microflora by exposing nutrient agar plate at different locations and comparing diversity on the basis of colony morphology. Demonstration of bacterial smear preparation from suitable sample/culture followed by Gram staining and observation under oil immersion objective. Preparation of stained temporary mounts of any one fungus (*Rhizopus/ Penicillium*) and any one alga (*Chlamydomonas/ Spirogyra*). **16**

Unit 6: Study of microorganisms: Study of shape and arrangement of following bacteria / bacterial structures using permanent slides: bacillus, coccus, spirillum and endospore. Study of vegetative and reproductive structures of following algae using permanent slides: *Chlamydomonas*, *Spirogyra* and *Polysiphonia/Fucus*. Study of vegetative and reproductive structures of following fungi and protozoa using permanent slides: Fungi: *Rhizopus*, *Penicillium* and *Agaricus*. Protozoa: *Amoeba*, *Paramecium*, and *Giardia*. Study of structure of the following viruses using electron micrographs: Tobacco mosaic virus, T4 bacteriophage and poliovirus. **20**

Suggested Reading:

1. Brock Biology of Microorganisms by M.T. Madigan, J. Aiyer, D. Buckley, W. Sattley and B. Stahl. 16th edition. Pearson, USA. 2021.
2. Microbiology: A Laboratory Manual by J. Cappuccino and C.T. Welsh. 12th edition. Pearson Education, USA. 2020.
3. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019.

4. Microbiology: An Introduction by G.J. Tortora, B.R. Funke, and C.L. Case. 13th edition. Pearson, USA. 2018.
5. Benson's Microbiological applications: Laboratory manual in general microbiology by A.E. Brown and H. Smith H. 15th edition. McGraw-Hill Education, USA. 2022.
6. Principles of Microbiology by R. M. Atlas. 2nd edition. W.M.T. Brown Publishers, USA. 1997.
7. Microbiology by M. J. Pelczar, E. C. S. Chan and N. R. Krieg. 5th edition. McGraw Hill, USA. 1993.

Facilitating the Achievement Of Course Learning Objectives

Unit	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Will become familiar with the history of Microbiology, and understand how Microbiology developed as a distinct discipline of science during the golden era of microbiology. Will become familiar with some of the later developments of the 21 st century.	Classroom lectures on the discovery of microorganisms, controversy over spontaneous generation, discoveries in the golden age of microbiology and latest developments in 21 st century.	Identification of scientists through photographs related to development of Microbiology. Home assignment on historical developments that led to the development of germ theory of disease, pure culture technique and immunization.
2.	Will acquire an understanding about the placement of microorganisms in the tree of life. Will know about key differences between prokaryotic and eukaryotic organisms. Will also be acquainted with structure of viruses, general characteristics and importance of algae, fungi and protozoa.	Lecture on classification of living organism with emphasis on placement of microorganisms. Presentations on prokaryotic and eukaryotic microbial cell structure, structure of virus and economic importance of algae, fungi and protozoa.	Assignments on acellular and cellular microbes with examples; comparative account of prokaryotic and eukaryotic cell structure. Quiz on economic importance of algae, fungi and protozoa.
3.	Will understand the importance of microbe-human interactions, becoming aware of microorganisms as agents of human diseases. Will become	Presentations on common human diseases with their causative agents and mode of transmission. Interactive sessions on the role of different microorganisms in human welfare.	Quiz on common human diseases and their agents. Poster making on microorganisms used in making of foods, biofuels, enzymes,

	aware of the important role that microorganisms play in food, agriculture, industry, biofuel and in the clean-up of the environment.		biofertilizers, and antibiotics.
4	Will become aware of good microbiological laboratory and safety practices, and be acquainted with the working of basic microbiological equipment routinely used in the laboratory. Will also be acquainted with the aseptic techniques used for culturing bacteria and fungi.	Discussion on the importance of safety measures and good laboratory practices including disposal and proper handling of microbial cultures. Discussion and demonstration of working and applications of basic microbiological equipment. Demonstration of aseptic culture technique.	Making posters on good microbiology laboratory practices, comparative account of various biosafety levels (BSL1 to BSL4), safety in laboratories and immediate assistance in case of injury. Viva/quiz on functions of different components, and applications of instruments.
5.	Will gain hands-on experience in isolation of bacteria and fungi from air and will be acquainted with staining techniques used for observing bacteria, algae and fungi. Will learn the use of compound microscope.	Laboratory sessions for studying microbial flora of the air and practicing isolations by aseptic transfer of microorganisms. Demonstration of preparation of bacterial smears followed by Gram staining. Practical session for staining fungi and algae for observing under microscope.	Students are required to write a report for all the exercises in a record book. They will submit the practical record on a specified date and will be assessed for their laboratory work and the practical record work separately.
6.	Will get acquainted with different shapes and arrangement of bacteria. Will be able to identify algae, fungi, protozoa using permanent slides/photographs. Will be able to understand the structure of viruses using electron micrographs.	Observing permanent slides/photographs/ electron micrographs of various microorganisms for characteristic identifying features .	Recording salient features of various microorganisms alongwith well labelled diagrams in their practical files to be submitted at an informed time and assessing the record work.

*Assessment tasks are indicative and may vary.