MICROB-DSC101

INTRODUCTION TO THE MICROBIAL WORLD

Marks: 100 (Theory = 75 marks
Practicals = 25 marks)

Duration: Theory = 45 hours (3 credits)
Practicals = 30 hours (1 credit)

Course Objectives:

The main objective of this course is to introduce students to the world of microorganisms. Students will be made familiar with the major milestones that led to the shaping of microbiology as a distinct discipline of science. Students will gain insights into the diversity of microorganisms, understand their structural features, and appreciate the role of microorganisms in our day-to-day lives as well as in the sustenance of life on earth.

Pre-requisite: Student should have studied Biology/ Biotechnology/ Biochemistry in 12th standard

Course Learning Outcomes:
Upon successful completion of the course, the students will be able to:

CO1: Discuss the developments that led to the emergence of microbiology as a scientific discipline.

CO2: Understand current systems of classification being used for microorganisms and learn about cell organization in microorganisms.

CO3: Discourse on acellular forms of life such as viruses, viroids and prions.

CO4: Converse actively on the diversity, distribution, cell structure, reproduction and economic importance of protists.

CO5: Deliver information on the diversity, distribution, structure, life cycles and economic importance of fungi.

CO6: Appreciate the extensive and impressive impact of microorganisms in our day-to-day life and become aware of the vast scope of microbiology and its allied fields.

Contents:

Theory: **45 hours**

Unit 1: The Evolution of Microbiology as a Discipline of Science: The discovery of microorganisms, contributions of Anton van Leeuwenhoek, spontaneous generation vs. biogenesis, the germ theory of disease, the golden era of microbiology and major developments in the different fields of Microbiology in the late 20th century. Key contributions of the following scientists: Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner, Elie Metchnikoff, Ronald Ross, Dmitri Ivanovsky, Martinus Beijerinck, Stanley Prusiner, Paul Ehrlich, Alexander Fleming, Selman Waksman, Sergei N Winogradsky and Anand Mohan Chakraborty. **9**

Unit 2: Classification Systems: Whittaker's five kingdom classification system and Carl Woese's three domain classification system. Overview of acellular (viruses) and cellular micro-organisms (eubacteria, archaea, protista, fungi). Prokaryotic and Eukaryotic cell structure**.** **3**

Unit 3: Acellular microorganisms and protista:

Brief introduction to viruses: Structure (genetic material, capsid symmetry, envelope), host range, cultivation, bacteriophages (lytic and lysogenic). General characteristics of viroids and prions.

Algae: General characteristics including occurrence and thallus organization. Criteria for classification of algae: cell wall composition, pigments, flagellation, food reserves. Cell structure and reproduction of *Chlamydomonas* and *Chlorella*. Economic importance of algae.

Protozoa: General characteristics of protozoa with a reference to cell structure, modes of locomotion, modes of nutrition, and modes of reproduction. Morphology and importance of *Entamoeba histolytica, Tetrahymena* and *Giardia*. Ecological importance of protozoa.

Acellular and Cellular slime molds: a brief account **14**

Unit 4: Fungi: General characteristics: morphology, cell structure, nutritional requirements, cultivation, preservation and reproduction (asexual and sexual cycles). Structure, life cycle and economic importance of *Saccharomyce*s, *Rhizopus, Aspergillus,* and *Agaricus*. **9**

Unit 5: The scope of microbiology: an overview. Food and dairy industry: fermented foods, single cell protein. Human health and medicine: human microbiome, probiotics, vaccines, phage therapy. Microbes in environment: bioremediation, bioleaching, waste management, biogas, bioethanol, carbon sequestration. Microbes in agriculture: biocomposting, biofertilizers, biopesticides. Industrially important microbial products: organic acids, amino acids, antibiotics, enzymes, polysaccharides. Space microbiology: Current developments. **10**

Practicals: 30 hours

Unit 1: Principles of Good Laboratory Practice (GLP) and Introduction to aseptic techniques: Principles of Good Microbiological Laboratory Practices (GMLP). Concept of biosafety levels (BSLs). Work practices, safety equipment and protective measures to be used in laboratories of the different categories of biosafety levels BSL-1 to BSL-4. Microorganism risk groups: BSL-1 to BSL-4 microorganisms. Methods of disposal of microbial cultures. Sterilization by moist heat, mechanical (filtration), irradiation (UV), chemical (alcohol). Instruments for sterilization: Principle, working and applications of autoclave and hot air oven.

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Unit 2: Study of eukaryotic microorganisms: To study the morphological features and reproductive structures of the following using permanent slides/photographs: Fungi: *Rhizopus*, *Aspergillus, Penicillium, Saccharomyces.* Algae: *Chlamydomonas*, *Chlorella, Spirogyra.* Protozoa: *Amoeba, Paramecium, Entamoeba histolytica, Giardia.* To prepare temporary mounts of any two fungi and two algae from those mentioned above. **15**

Suggested Reading:

Theory:

1. Brock Biology of Microorganisms by M.T. Madigan,J. Aiyer,D. Buckley,W.Sattley and D. Stahl.16th edition. Pearson, USA. 2021.

2. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019.

3. Microbiology: An Introduction by G.J. Tortora, B.R. Funke,and C.L. Case. 13th edition. Pearson, USA. 2018.

4. Algal Biotechnology: Products and Processes. Edited by Bux F. and Chisti Y. 1st edition. Springer, Switzerland. 2016.

5. Principles of Microbiology by R. M. Atlas. 2nd edition. W.M.T. Brown Publishers, USA.1997.

6. Microbiology by M. J. Pelczar, E. C. S. Chan and N. R. Krieg. 5th edition. McGraw Hill,USA. 1993.

Practicals:

1. Microbiology: A Laboratory Manual by J. Cappuccino and C.T. Welsh. 12th edition. Pearson Education, USA. 2020.

2. Basic Lab Manual of Microbiology, Biochemistry and Molecular Biology by A. Ray and R. Mukherjee. Taurean Publisher, India. 2019.

3. Benson's Microbiological applications: Laboratory manual in general microbiology by A.E. Brown and H. Smith H. 15th edition. McGraw-Hill Education, USA. 2022.

4. Manual of Microbiology: Tools & Techniques by A.K. Sharma. 1st edition. Ane Books, India. 2007.

Facilitating the achievement of course learning objectives

S. No.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Discuss the developments that led to the emergence of microbiology as a scientific discipline	Discussion on the discovery of microorganisms and the controversy over spontaneous generation, discoveries in the golden age of microbiology and developments in the field in late 20th century.	Quiz, match the following, and identification of scientists through photographs
2.	Understand current systems of classification being used for microorganisms and learn about cell organization in microorganisms	Interactive lectures on different systems of classification, prokaryotic and eukaryotic cell structure, acellular and cellular microorganisms using visual aids and power point presentations.	Multiple choice questions and diagrammatic representations.
3.	Discourse on acellular forms of life such as viruses, viroids and prions.	Interactive lectures on helical, icosahedral and complex capsid symmetry of viruses, host range and cultivation of viruses. Differences between viroids and prions.	Diagrammatic depiction of various symmetry types, and identification using electron micrographs.

4.	Converse actively on the diversity, distribution, cell structure, reproduction and economic importance of protists of protists	Detailed discussion on the general characteristics and economic importance of algae, protozoa, and slime molds.	Class test on definitions and short notes.
5.	Deliver information on the diversity, distribution, structure, life cycles and economic importance of fungi	Interactive lectures on cell structure and reproduction in fungi with the help of charts and visual aids. Group discussion on the economic importance of common fungi.	Drawing diagrams of morphology and life cycles of common fungal genera. Quiz on the economic importance of fungi and fungal associations.
6.	Appreciate the extensive and impressive impact of microorganisms in our day-to-day life and become aware of the vast scope of microbiology and its allied fields.	Discussion on the the scope of microbiology in various fields, taking practical examples from day-to-day life.	Essay writing and poster making on scope of microbiology highlighting latest interesting findings of practical importance.

***Assessment tasks listed here are indicative and may vary**