

| DEPARTMENT OF MICROBIOLOGY |                |             |                    | CLASS: I M.Sc. Microbiology |                    |     |     |       |
|----------------------------|----------------|-------------|--------------------|-----------------------------|--------------------|-----|-----|-------|
| Sem                        | Course Type    | Course Code | Course Title       | Credits                     | Contact Hours/week | CIA | Ext | Total |
| I                          | Major Core - 1 | 21P1RMC1    | Microbial Taxonomy | 4                           | 5                  | 25  | 75  | 100   |

| Nature of Course    |   |  |                           |
|---------------------|---|--|---------------------------|
| Knowledge and skill | ✓ |  | Employability oriented    |
| Skill oriented      |   |  | Entrepreneurship oriented |

| Course Objectives  |
|--|
| <ol style="list-style-type: none"> <li>To recollect history, classification and diversity of microbes</li> <li>To differentiate various groups of bacteria</li> <li>To outline the unique features and reproduction of fungi</li> <li>To understand the classification and significance of algae</li> <li>To gain knowledge about classification and general characteristics of viruses</li> </ol> |

| Course Learning Outcomes  |
|---|
| <p><i>On successful completion of the programme, the students will be able to</i></p> <ol style="list-style-type: none"> <li>Classify the microorganisms</li> <li>Compare and contrast prokaryotes and eukaryotes</li> <li>Interpret the characteristics and significance of fungi</li> <li>Compare algal and cyanobacterial members</li> <li>Explain the classification and nomenclature of viruses</li> </ol> |

| Unit | Description   | Hours | K-level  | CLO |
|------|---|-------|----------|-----|
| I    | <p><b>Unit I – Classification and diversity of microorganisms</b><br/>           History, diversity of microorganisms and contributions of Indian scientists in the field of microbial classification. Systems of classification - Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Principles of taxonomical classification of Eubacteria (Bacteria and Archaea). Major characteristics used in taxonomy - cultural, morphological, biochemical, physiological, genetic and molecular characteristics. Numerical Taxonomy (Taxometrics) and Chemotaxonomy. Assessing microbial phylogeny – chronometers, phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.</p> | 15Hrs | Up to K2 | 1   |

|     |  |       |          |   |
|-----|--|-------|----------|---|
| II  | <b>Unit II – Taxonomy of bacteria</b><br>Bergey’s system of classification of bacteria. Nomenclature of bacteria. Structure and functions of Bacterial cellwall (Gram positive and Gram negative), slime layer, capsule, pili, flagella and other inclusions bodies. Ultra structure of bacteria- <i>Streptococcus</i> sp., <i>Corynebacterium</i> sp., <i>Pseudomonas</i> sp. Characteristics and types of Archaeabacteria. Unique features of Mycoplasma. Structure, formation and significance of bacterial endospores ( <i>Bacillus</i> ). | 15Hrs | Up to K3 | 2 |
| III | <b>Unit III - Taxonomy of fungi</b><br>Classification of fungi (Alexopoulos and Mims). General characteristics of fungi - habitat, distribution, nutritional requirements, ultra structure of thallus, cell wall structure, asexual reproduction, sexual reproduction and significance. Life cycles - Ascomycetes ( <i>Aspergillus</i> ), Deuteromycetes ( <i>Candida</i> ), Zygomycetes ( <i>Mucor</i> ) and Basidiomycetes ( <i>Agaricus</i> ). Endophytes.  | 15Hrs | Up to K3 | 3 |
| IV  | <b>Unit IV - Taxonomy of algae</b><br>Classification of algae by Fritsch. General characteristics of algae – occurrence and thallus organization. Ultra structure, pigments, flagella, food reserves and vegetative, asexual reproduction, sexual reproduction and significance - Chlorophyta ( <i>Ulothrix</i> ), Chrysophyta ( <i>Diatoms</i> ), Rhodophyta ( <i>Gracillaria</i> ) and Cyanophyta ( <i>Spirulina</i> , <i>Nostoc</i> , <i>Oscillatoria</i> , <i>Synechococcus</i> , <i>Chroococcus</i> ).                                    | 15Hrs | Up to K4 | 4 |
| V   | <b>Unit V - Taxonomy of viruses</b><br>Classification of Viruses - Structure-based classification, International Committee on Taxonomy of Viruses (ICTV) and Baltimore classification. Definition and concept of viroids, virusoids, satellite viruses and Prions. General characteristics, nomenclature, morphology and reproduction - Bacteriophage (T4 and Lambda), Animal viruses (Polio, SARS and Corona), Plant viruses (TMV and CMV), Mycophage and Cyanophage.   | 15Hrs | Up to K4 | 5 |

**Total 75 Hours**

**Books for study:**

1. Pelczar, Jr. M.J., Chan, E.C.S. and Kreig, N.R. (2006). Microbiology. 5<sup>th</sup> Edition. McGraw Hill Inc., New York.
2. Madigan, M.T. and Martinko, J.M. (2014). Brock Biology of Micro-organisms. 14<sup>th</sup> Edition. Parker J. Prentice Hall International, Inc., New Jersey.

**Books for reference:**

1. Prescott, L.M., Harley, J.P. and Klein, D.A. (2005). Microbiology. McGraw Hill Inc., New York.
2. Boyd, R.F. (1991). General Microbiology. 2<sup>nd</sup> Edition. Times Mirror/Moshy College Publishing, Virginia.
3. Atlas, R.M. (1997). Principles of Microbiology. 2<sup>nd</sup> Edition. W.M.T.Brown Publishers, Iowa.

- Black, J.G. (2008). Microbiology: Principles and Explorations. 7<sup>th</sup> Edition. Prentice Hall, US.
- Srivastava, S. and Srivastava, P.S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.
- Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. (2005). General Microbiology. 5<sup>th</sup> Edition. McMillan, London.
- Tortora, G.J., Funke, B.R. and Case, C.L. (2008). Microbiology: An Introduction. 9<sup>th</sup> Edition. Pearson Education, London.
- Willey, J.M., Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9<sup>th</sup> Edition. McGraw Hill Higher Education, New York.

#### Web resources:

- <https://microbenotes.com/classification-of-bacteria/>
- [https://www.brainkart.com/article/Ultrastructure-of-a-Bacterial-cell\\_32841/](https://www.brainkart.com/article/Ultrastructure-of-a-Bacterial-cell_32841/)
- <https://www.toppr.com/guides/biology/biological-classification/kingdom-fungi/>
- <https://www.toppr.com/guides/biology/plant-kingdom/algae/>
- <https://www.sciencedirect.com/topics/immunology-and-microbiology/virus-classification>
- <https://www.youtube.com/watch?v=8IJRzcPC9wg>

#### Rationale for nature of the course

Microbial Taxonomy deals with three important disciplines like classification, nomenclature and identification of microbes thus enabling to explore microbes and their taxonomical position in microbial world. A universal language of classification system can be understood.

#### Activities having direct bearing on skill development/ employability/entrepreneurship

- Identify and prepare phylogenetic tree
- Understand the similarities and differences among microbes
- Explore the economic importance of microbes

#### Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

#### Course Learning Outcomes (CLO)

On the completion of the course the student will be able to

| CLOs | Course Learning Outcomes                                | Knowledge Level |
|------|---|-----------------|
| CLO1 | Classify the microorganisms                             | Up to K2        |
| CLO2 | Compare and contrast prokaryotes and eukaryotes         | Up to K3        |
| CLO3 | Interpret the characteristics and significance of fungi | Up to K3        |
| CLO4 | Compare algal and cyanobacterial members                | Up to K4        |
| CLO5 | Explain the classification and nomenclature of viruses  | Up to K4        |

## Mapping of Course Learning Outcomes with Programme Specific Outcomes

|      | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|------|------|------|------|------|------|
| CLO1 | 3    | 2    | 1    | 1    | 2    |
| CLO2 | 2    | 2    | 2    | 2    | 2    |
| CLO3 | 2    | 2    | 3    | 3    | 2    |
| CLO4 | 2    | 3    | 3    | 3    | 2    |
| CLO5 | 3    | 2    | 2    | 3    | 3    |

Advance application – 3 Intermediate level – 2 Basic level – 1

## Mapping of Course Outcome with Programme Outcomes

|      | PO1 | PO2 | PO3 | PO4 | PO5 |
|------|-----|-----|-----|-----|-----|
| CLO1 | 2   | 3   | 1   | 2   | 3   |
| CLO2 | 3   | 3   | 2   | 2   | 3   |
| CLO3 | 3   | 2   | 3   | 2   | 3   |
| CLO4 | 3   | 2   | 3   | 3   | 3   |
| CLO5 | 2   | 2   | 3   | 2   | 3   |

Advance application – 3 Intermediate level – 2 Basic level – 1

## Learning Outcome Based Education & Assessment (LOBE)

### Blue Print

### Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

| S. No.                          | CLOs  | K-Level  | Section A           |         | Section B           |         | Section C<br>(Either / or<br>Choice) | Section<br>D<br>(Open<br>Choice) |
|---------------------------------|-------|----------|---------------------|---------|---------------------|---------|--------------------------------------|----------------------------------|
|                                 |       |          | MCQs                |         | Short Answers       |         |                                      |                                  |
|                                 |       |          | No. of<br>Questions | K-Level | No. of<br>Questions | K-Level |                                      |                                  |
| 1.                              | CLO 1 | Up to K2 | 2                   | K2 & K2 | 1                   | K1      | 2 (K1&K1)                            | 1(K2)                            |
| 2.                              | CLO 2 | Up to K3 | 2                   | K3 & K3 | 1                   | K1      | 2 (K3&K3)                            | 1(K3)                            |
| 3.                              | CLO 3 | Up to K3 | 2                   | K3 & K3 | 1                   | K2      | 2 (K2&K2)                            | 1(K3)                            |
| 4.                              | CLO 4 | Up to K4 | 2                   | K4& K4  | 1                   | K2      | 2 (K4&K4)                            | 1(K4)                            |
| 5.                              | CLO 5 | Up to K4 | 2                   | K1& K1  | 1                   | K3      | 2 (K4&K4)                            | 1(K4)                            |
| No. of Questions to be asked    |       |          | 10                  |         | 5                   |         | 10                                   | 5                                |
| No. of Questions to be answered |       |          | 10                  |         | 5                   |         | 5                                    | 3                                |
| Marks for each Question         |       |          | 1                   |         | 2                   |         | 5                                    | 10                               |
| Total Marks for each Section    |       |          | 10                  |         | 10                  |         | 25                                   | 30                               |

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving Problems

K4 – Examining, analyzing, presentation and make interferences with evidences

### Distribution of Section-wise Marks with K Levels

| K Levels    | Section A<br>(No Choice) | Section B<br>(No Choice) | Section C<br>(Either/or) | Section D<br>(Open Choice) | Total Marks | % of Marks without choice | Consolidated |
|-------------|--------------------------|--------------------------|--------------------------|----------------------------|-------------|---------------------------|--------------|
| K1          | 2                        | 4                        | 10                       | -                          | 16          | 13.33                     | 35 %         |
| K2          | 2                        | 4                        | 10                       | 10                         | 26          | 21.67                     |              |
| K3          | 4                        | 2                        | 10                       | 20                         | 36          | 30                        | 30%          |
| K4          | 2                        | -                        | 20                       | 20                         | 42          | 35                        | 35%          |
| Total Marks | 10                       | 10                       | 50                       | 50                         | 120         | 100.00                    | 100%         |

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving Problems

K4 – Examining, analyzing, presentation and make interferences with evidences

### LESSON PLAN

| Units   | Description   | Staff | Hours | Mode           |
|---|---|-------|-------|----------------|
| <b>I</b><br><b>Classification and diversity of microorganisms</b> | a) History, diversity of microorganisms and contributions of Indian scientists in field of Microbial classification.  |       | 3     | Chalk and Talk |
|   | b) Systems of classification Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.   |       | 4     |                |
|   | c) Principles of taxonomical classification of Eubacteria (Bacteria and Archaea). Major characteristics used in taxonomy: cultural, morphological, biochemical, physiological, genetic and molecular characteristics; Numerical Taxonomy (Taxometrics) and Chemotaxonomy. |       | 5     |                |
|   | d) Assessing Microbial Phylogeny- chronometers. phylogenetic trees, r-RNA, DNA and proteins as indicators of phylogeny.   |       | 3     |                |
| <b>II</b><br><b>Taxonomy of bacteria</b>                          | a) Bergey's system of classification of bacteria. Nomenclature of bacteria.   |       | 4     | Chalk and Talk |
|   | b) Structure and functions of Bacterial cell wall (Gram positive, Gram negative),   |       | 3     |                |
|   | c) Slime layer, capsule, pili, flagella and other inclusions bodies. Ultra structure of bacteria- <i>Streptococcus</i> sp. <i>Corynebacterium</i> sp. and <i>Pseudomonas</i> sp.  |       | 2     |                |
|   | d) Characteristics and types of Archaeobacteria. Unique features of Mycoplasma  |       | 4     |                |
|   | e) Structure, formation and significance of bacterial endospores ( <i>Bacillus</i> ).   |       | 2     |                |

|                                      |  |  |   |                        |
|--------------------------------------|--|--|---|------------------------|
| <b>III<br/>Taxonomy of<br/>fungi</b> | a) Classification of fungi (Alexopoulos and Mims).   |  | 3 | Chalk<br>and<br>Talk   |
|                                      | b) General characteristics of fungi - habitat, distribution, nutritional requirements, ultra- structure of thallus, cell wall structure, asexual reproduction, sexual reproduction and significance.     |  | 5 |                        |
|                                      | c) Life cycles - Ascomycetes ( <i>Aspergillus</i> ), Deuteromycetes ( <i>Candida</i> )   |  | 4 |                        |
|                                      | d) Zygomycetes ( <i>Mucor</i> ), Basidiomycetes ( <i>Agaricus</i> ). Endophytes.   |  | 3 |                        |
| <b>IV<br/>Taxonomy of<br/>algae</b>  | a) Classification of algae by Fritsch.   |  | 3 | Chalk<br>&Talk,<br>PPT |
|                                      | b) General characteristics of algae – occurrence and thallus organization.   |  | 3 |                        |
|                                      | c) Ultra-structure, pigments, flagella, food reserves vegetative, asexual and sexual reproduction and significance - Chlorophyta ( <i>Ulothrix</i> ), Chrysophyta ( <i>Diatoms</i> )                     |  | 3 |                        |
|                                      | d) Ultra-structure, pigments, flagella, food reserves vegetative, asexual and sexual reproduction and significance - Rhodophyta ( <i>Gracillaria</i> ) and Cyanophyta - <i>Spirulina</i> , <i>Nostoc</i> |  | 3 |                        |
|                                      | e) Ultra-structure, pigments, flagella, food reserves vegetative, asexual and sexual reproduction and significance - <i>Oscillatoria</i> , <i>Synechococcus</i> , <i>Chroococcus</i> .                   |  | 3 |                        |
| <b>V<br/>Taxonomy of<br/>viruses</b> | a) Classification of Viruses - Structure-based classification, International Committee on Taxonomy of Viruses (ICTV) and Baltimore classification.   |  | 4 | Chalk<br>&Talk,<br>PPT |
|                                      | b) Definition and concept of viroids, virusoids, satellite viruses and Prions  |  | 2 |                        |
|                                      | c) General characteristics, nomenclature, morphology and reproduction – Bacteriophage (T4 and Lambda),   |  | 2 |                        |
|                                      | d) Animal viruses (Polio, SARS and Corona)   |  | 3 |                        |
|                                      | e) Plant viruses (TMV, CMV), Mycophage and Cyanophage.   |  | 4 |                        |

**Course designers:**

**1. Mrs.K.Rajeswari**