

# **Sadakathullah Appa College**

**(Autonomous)**

**(Reaccredited by NAAC at an 'A' Grade. An ISO 9001:2015 Certified Institution)**

**Rahmath Nagar, Tirunelveli- 11.**

**Tamil Nadu.**

## **DEPARTMENT OF MICROBIOLOGY**



**Draft CBCS SYLLABUS**

**For**

**M.Sc., Microbiology**

**(Applicable for students admitted in June 2021 and onwards)**

**(Submitted before the Microbiology BOS Meeting**

**to be held on 16.02.2021)**

**COURSE Pattern**  
**CBCS Syllabus – M.Sc Micro Biology**  
**(Applicable for students admitted in June 2021 and onwards)**

| SEM | Category     | Title of the Courses  | S. Code   | H/W | L | T | P | C | Marks |   |   |  |
|-----|--------------|---|-----------|-----|---|---|---|---|-------|---|---|--|
|     |              |   |           |     |   |   |   |   | I     | E | T |  |
| I   | DSC-I        | General Microbiology and Bacteriology                                 | 21PCMB11  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSC-II       | Techniques in Microbiology  | 21PCMB12  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSC-III      | Microbial Diversity and Classification                                | 21PCMB13  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSE-IA       | Agricultural Environmental and Marine Microbiology                    | 21PEMB11A | 4   | 3 | 1 |   | 4 |       |   |   |  |
|     | DSE-IB       | Advance Microbiology  | 21PEMB11B |     |   |   |   |   |       |   |   |  |
|     | DSE-IC       | Bioethics, Biosafety and Intellectual Property Rights                 | 21PEMB11C |     |   |   |   |   |       |   |   |  |
|     | P-I          | Techniques in Bacteriology  | 21PCMB1P1 | 4   |   |   |   | 4 | 2     |   |   |  |
|     | P-II         | Techniques in Agricultural, Environmental and Marine Microbiology     | 21PCMB1P2 | 4   |   |   |   | 4 | 2     |   |   |  |
|     | IDC          | Microbiology and Human Health   | 21PIMB11  | 2   |   |   |   |   | 2     |   |   |  |
|     | Library Hour |   | 1         |     |   |   |   | - |       |   |   |  |
| II  | DSC-IV       | Microbial Biochemistry  | 21PCMB21  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSC-V        | Microbial Physiology and Metabolism                                   | 21PCMB22  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSC-VI       | Molecular Biology and Genetic Engineering                             | 21PCMB23  | 5   | 4 | 1 |   | 4 |       |   |   |  |
|     | DSE-IIA      | Virology  | 21PEMB21A | 4   | 3 | 1 |   | 4 |       |   |   |  |
|     | DSE-IIB      | Food Safety, Quality Control And Sensory Evaluation                   | 21PEMB21B |     |   |   |   |   |       |   |   |  |
|     | DSE-IIC      | Fermentation Technology   | 21PEMB21C |     |   |   |   |   |       |   |   |  |
|     | P-III        | Techniques in Microbial physiology                                    | 21PCMB2P1 | 4   |   |   |   | 4 | 2     |   |   |  |
|     | P-IV         | Techniques in biochemistry, molecular biology and genetic engineering | 21PCMB2P2 | 4   |   |   |   | 4 | 2     |   |   |  |
|     | SEC          | SEC-I (MOOC NPTEL Course)   | 21PSMB21  | 2   |   |   |   |   | 2     |   |   |  |
|     | Library Hour |   | 1         |     |   |   |   | - |       |   |   |  |

|     |              |   |              |            |   |   |  |           |   |  |  |  |
|-----|--------------|---|--------------|------------|---|---|--|-----------|---|--|--|--|
| III | DSC-VII      | Immunology  | 21PCMB31     | 5          | 4 | 1 |  | 4         |   |  |  |  |
|     | DSC-VIII     | Medical Microbiology  | 21PCMB32     | 5          | 4 | 1 |  | 4         |   |  |  |  |
|     | DSC-IX       | Research Methodology and Biostatistics                      | 21PCMB33     | 5          | 4 | 1 |  | 4         |   |  |  |  |
|     | DSE-III A    | Quality assurance in Microbiology                           | 21PEMB31A    | 4          | 3 | 1 |  | 4         |   |  |  |  |
|     | DSE-III B    | Forensic Microbiology                                       | 21PEMB31B    |            |   |   |  |           |   |  |  |  |
|     | DSE-III C    | Veterinary Microbiology                                     | 21PEMB31C    |            |   |   |  |           |   |  |  |  |
|     | P-V          | Techniques in Immunology and Research Methodology           | 21PCMB3P1    | 4          |   |   |  | 4         | 2 |  |  |  |
|     | P-VI         | Techniques in Medical and Quality assurance in Microbiology | 21PCMB3P2    | 4          |   |   |  | 4         | 2 |  |  |  |
|     | IDC-II       | Entrepreneurship in Microbiology                            | 21PIMB31     | 2          |   |   |  |           | 2 |  |  |  |
|     | Library Hour |   | 1            |            |   |   |  | -         |   |  |  |  |
| IV  | DSC-X        | Food and Dairy Microbiology                                 | 21PCMB41     | 5          |   |   |  | 4         |   |  |  |  |
|     | DSC-XI       | Industrial and Pharmaceutical Microbiology                  | 21PCMB42     | 5          |   |   |  | 4         |   |  |  |  |
|     | P            | Project   | 21PPMB41     | 8          |   |   |  | 8         |   |  |  |  |
|     | DSE-IV A     | Advances in Biotechnology                                   | 21PEMB41A    | 4          | 3 | 1 |  | 4         |   |  |  |  |
|     | DSE-IV B     | Vermiculture Techniques and Mushroom Technology             | 21PEMB41B    |            |   |   |  |           |   |  |  |  |
|     | DSE-IV C     | Environment and waste Management                            | 21PEMB41C    |            |   |   |  |           |   |  |  |  |
|     | P-VII        | Techniques in Food and Dairy Microbiology                   | 21PCMB4P1    | 4          |   |   |  | 4         | 2 |  |  |  |
|     | P-VIII       | Techniques in Industrial and Pharmaceutical Microbiology    | 21PCMB4P2    | 4          |   |   |  | 4         | 2 |  |  |  |
|     |              |   | <b>Total</b> | <b>120</b> |   |   |  | <b>90</b> |   |  |  |  |

# Programme Learning Outcomes (PLO)

(Aligned with Graduate Attributes) for

## **Master of Science (M.Sc.)**

The students Post graduating with the Degree M.Sc. will be able to:

| <b>PLO</b> | <b>Upon completion of M.Sc. Degree Programme, the graduates will be able to:</b>  |
|------------|---|
| PLO 1      | <b>Disciplinary Knowledge</b> <ul style="list-style-type: none"><li>• Acquire in-depth scientific knowledge in the core areas of study.</li></ul>   |
| PLO 2      | <b>Creative Thinking and Practical Skills / Problem Solving Skills</b> <ul style="list-style-type: none"><li>• Enrich skills of observation to draw logical inferences from scientific experiments/ programming and skills of creative thinking to develop novel ideas.</li><li>• Hone problem solving skills in theoretical, experimental and computational areas and to apply them in real life situations.</li></ul>   |
| PLO 3      | <b>Sense of inquiry and Skilled Communicator / Research, Innovation and Entrepreneurship</b> <ul style="list-style-type: none"><li>• Develop the capability for raising appropriate questions relating to the current/emerging issues encountered in the scientific field and to plan, execute and express the results of experiments / investigations through technical writings as well as through oral presentations.</li><li>• Design innovations for exploring the unexplored areas in diverse fields to accomplish socially relevant and economically beneficial innovative research projects.</li><li>• Become a skilled entrepreneur for launching start-up / business ventures to improve the economy of the nation.</li></ul> |
| PLO 4      | <b>Ethical Awareness / Team Work / Environmental Conservation and Sustainability</b> <ul style="list-style-type: none"><li>• Equip them for conducting work as an individual or as a member, or as a leader in diverse teams upholding values such as honesty and</li></ul>   |

|       |   |
|-------|---|
|       | <p>precision, and thus preventing unethical behaviours such as fabrication, falsification, misrepresentation of data, plagiarism etc. to ensure academic integrity.</p> <ul style="list-style-type: none"> <li>• Realise that the environment and humans depend on one another and to know about the responsible management of our ecosystem for survival, and for the well-being of the future generation as well.</li> </ul>  |
| PLO 5 | <p><b>Digital Literacy/Self-Directed Learning/Usage of ICT/Lifelong Learning</b></p> <ul style="list-style-type: none"> <li>• Get access to digital resources, to use them judiciously for updation of knowledge and also to engage in remote/ independent learning.</li> <li>• Inculcate the habit of learning continuously through the effective adoption of ICT to update knowledge in the emerging areas in Sciences for inventions/discoveries so that the knowledge transferred from laboratory to land would yield fruitful results for the betterment of global society.</li> </ul> |

### Programme Specific Outcomes

| <b>PSO</b> | <b>Upon completion of M.Sc. Microbiology Degree Programmes, the students will be able to:</b>   | <b>PLOs Mapped</b> |
|------------|---|--------------------|
| PSO-1      | Understand and acquire the advanced level information in the field of Microbiology and study the vast array of microbes to their diversity, structure by influencing the world.                       | 1,3                |
| PSO-2      | Keep abreast of the recent techniques in Microbiology and provide them with the basic laboratory skills required for a career either in applied or research Microbiology.                             | 3,5                |
| PSO-3      | Help themselves to get through competitive examinations such as CSIR, NET, SET etc. by means of a thorough understanding of the syllabus prescribed.  | 4,1                |
| PSO-4      | Identify the different microbial processes used in industries and clinical laboratories.  | 3,4                |
| PSO-5      | Apply theories related to the various recent emerging areas of Microbiology and acquire the knowledge to analyze the Quality Laboratory Management (QLM) ethical issues regarding the modern Biology. | 2,5                |

## SEMESTER – I

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>GENERAL MICROBIOLOGY AND BACTERIOLOGY</b> |
| Total Hrs           | 75   |
| Hrs/Week            | 5  |
| Sub.Code            | 21PCMB11                                     |
| Course Type         | DSC 1  |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

The course helps to create curiosity in microbial world with the basic, advanced concepts of General Microbiology and Bacteriology.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>   |
|---------------|--|
| CO-1          | Understand the microbial world.  |
| CO-2          | Interpret the taxonomy and classification of bacteria.                           |
| CO-3          | Analyze the origin, classification, characteristics and diversity of Eubacteria. |
| CO-4          | Evaluate the methods of cultivation of bacteria.                                 |
| CO-5          | Create the advanced taxonomic tools for bacterial identification.                |

### Unit I: Microbial World (15 hours)

Discovery of microbial world - Controversy over Spontaneous generation; Microbes and the Origin of Life on Earth; Germ Theory; Microbial Evolution. History of Microbiology and contributions of Antonie Von Leeuwenhoek, Lazzaro Spallanzani, Paul Ehrlich, Edward Jenner, Louis Pasteur, Hans Christian Gram, R. J. Petri, Robert Koch, Charles Laveran, Martinus Beijerinck, Sergei Winogradsky, Alexander Fleming, Selman Waksman; Fanny Hesse, Kiyoshi Shiga, Emil Adolf von Behring, Sir Ronald Ross, Dimitri Ivanovski, Charles Louis Alphonse Laveran, Max Theiler, Selman Abraham Waksman, Kary Mullis.

### Unit II: Taxonomy and Classification (15 hours)

Taxonomy and Classification - Introduction to the Bergey's Manual of Determinative Bacteriology. Concepts proposed by Carl Linnaeus, Ernst Haeckel, Herbert F. Copeland, Robert Whittaker, Carl Woese, Cavalier Smith and Ruggiero; Introduction to microbial biodiversity – distribution, abundance, ecological niche. Types - Bacterial, Archaeal and Eucaryal.

### **Unit III: Eubacteria (15 hours)**

Eubacteria – Origin, Characteristics, Classification, Diversity, Association and Lifecycle. Morphology and Ultrastructure of Bacteria - Size, Shape and Arrangement of bacteria; Structure and Chemical composition of Cell Wall of Gram positive, Gram negative bacteria and archae; Wall-less Bacteria; Structure, Composition and Function of Cell membrane, Cytoskeleton (FtsZ, MreB, Crescentin), Capsule, Flagella, Pilli, Gas vesicles, Cytoplasmic matrix, Reserve food materials, Chromosomes, Inclusions - Carbon storage, Inorganic storage, Non-storage functions (Magnetosomes), Nucleoid and Endospores.

### **Unit IV: Cultivation of Bacteria (15 hours)**

Cultivation of bacteria - Aerobic, Anaerobic, Microaerophilic, Capnophilic; Culture Media - types based on the state - liquid, solid, semisolid; composition and use. General-purpose media/basic media (Peptone-water, nutrient broth, and nutrient agar), Enriched medium (Blood Agar, Chocolate Agar), Selective medium (Thayer Martin Agar, Mannitol Salt Agar, MacConkey's Agar, Cetrimide Agar, EMB Agar, TCBS Agar), Enrichment media (Selenite F broth, Tetrathionate Broth and Alkaline Peptone Water), Transport media (Cary Blair transport medium, Venkatraman Ramakrishnan (VR) medium), Anaerobic media (Robertson Cooked Meat (RCM) medium, Thioglycollate broth), Assay media (antibiotic assay media); pH indicators, Inoculation methods and instruments.

### **Unit V: Advanced Taxonomic Tools for Bacterial Identification (15 hours)**

Polyphasic Taxonomy - Phenotypic methods - Classical phenotypic analysis, Numerical analysis. Genotypic methods -DNA-DNA Hybridization, rRNA Homology, DNA-based typing. Whole-Cell Fatty acid analysis, MALDI- TOF.

#### **TEXTBOOKS:**

1. Aneja K. R., Jain P. & Aneja R. *A text book of basic & applied Microbiology*, New Age Int. Publ, New Delhi, 2008.
2. Pelczar Jr., M.J., Chan E.C.S. and Kreig, N.R. *Microbiology*. McGraw Hill Inc., New York, 1993.
3. Talaro K.P. and Talaro A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College Woolverton, 2007.

#### **REFERENCE BOOKS:**

1. Berg J. M., Tymoczko J. L. and Stryer, L. *Biochemistry* 6th Ed. W.H. Freeman and Company, New York, 2007.
2. Nelson D. and Cox M. M. *Principles of Biochemistry* 5th Ed. W.H. Freeman and Company, New York, 2009.
3. Prescott L.M., Harley J.P. and Klein D. A. *Microbiology* (11th edition). McGraw Hill, New York, 2020.
4. Wilson K. and Walker J. *Principles and Techniques of Biochemistry and Molecular Biology*. 6<sup>th</sup>Ed. Cambridge University Press, 2008.



### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Discuss the fundamental concepts of Microbial world.                               | 1              | Understanding   |
| CO-2   | Interpret the modern trends in the classification of microbes.                     | 2,3            | Applying        |
| CO-3   | Analyze the morphology and ultra structure of Bacteria.                            | 1,4            | Analyzing       |
| CO-4   | Assemble the nutritional types of Bacteria, growth kinetics of different Bacteria. | 4              | Evaluating      |
| CO-5   | Conclude the general characters and classification of Archae and Eubacteria.       | 5              | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course                   |       |       |       |                                    | Hours | Credit |       |       |
|--|------------------------------------|---------------------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I  | 21PCMB11                           | GENERAL MICROBIOLOGY AND BACTERIOLOGY |       |       |       |                                    | 75    | 4      |       |       |
| Course Outcomes (COs)  | Programme Learning Outcomes (PLOs) |                                       |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|  | PLO 1                              | PLO 2                                 | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1   | ✓                                  |                                       | ✓     | ✓     | ✓     | ✓                                  |       | ✓      |       | ✓     |
| CO-2   | ✓                                  | ✓                                     |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-3   | ✓                                  | ✓                                     |       |       | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-4   |                                    | ✓                                     | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-5   | ✓                                  | ✓                                     |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| Number of matches (✓) = 36<br>Relationship = High<br>Low (If the No. of matches are less than 25)<br>Medium (If the No. of matches are between 25 and 33)<br>High (If the No. of matches are more than 33) |                                    |                                       |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Suriya Prabha  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER – I

|                     |                                   |
|---------------------|-----------------------------------|
| <b>Course Title</b> | <b>TECHNIQUES IN MICROBIOLOGY</b> |
| <b>Total Hrs</b>    | 75                                |
| <b>Hrs/Week</b>     | 5                                 |
| <b>Sub.Code</b>     | 21PCMB12                          |
| <b>Course Type</b>  | DSC 2                             |
| <b>Credits</b>      | 4                                 |
| <b>Marks</b>        | 100                               |

### General Objective:

The course builds a sound knowledge in molecular techniques by helping themselves in gathering information in microbial techniques.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the basic principles of microscopy.                  |
| CO-2          | Demonstrate the principles and methods of sterilization.        |
| CO-3          | Analyze the various culture techniques.                         |
| CO-4          | Collect the knowledge of the applications of Spectrophotometry. |
| CO-5          | Assess the applications of Radiotherapy.                        |

### Unit I: Microscopy and Staining techniques (15 hours)

Basic Principles for the examination of microbes by Light, Dark field, Phase contrast, Confocal, Fluorescent and Electron (transmission and scanning) microscopy, Micrometry. Specimen Preparation and basic Principles of Simple, Gram, Capsule, Endospore, Flagella, Acid fast, Flurochrome staining, metachromatic , Nuclear/ Geimsa's staining.

### Unit II: Sterilization Techniques (15 hours)

Basic principles and methods of sterilization - Control of microorganisms by Physical methods- Heat (Dry, Moist heat), Pastuerization, Tyndallization, Filtration and Radiation; Chemical methods: Phenolics, Alcohols, Halogens, Heavy metals, Quaternary ammonium compounds, Aldehydes and Sterilizing gases; Evaluation of Antimicrobial agent and disinfectants effectiveness. Principle and functioning of LAF.

### Unit III: Culture Techniques (15 hours)

Morphological variations of Bacteria in Nutrient broth and agar. Biochemical characterization of bacteria: IMViC, Catalase Test. Coagulase Test, TSI test, Urease Test, Carbohydrate Fermentation test, CAMP test, Nitrate test. Pure culture techniques, Pour plate Spread plate method and Streak plate, Maintenance of Pure culture; Methods of Preservation of various microbes. Growth: Growth curve - batch, continuous and synchronous culture – factors influencing growth.

#### **Unit IV: Spectroscopy (15 hours)**

Basic Principles and Applications of Spectrophotometry- Beer-Lambert law; Interaction of radiation with matter, Absorption of radiation, Emission of radiation; UV-Vis Spectrophotometry, Flame photometry and atomic absorption Spectrophotometry; Chromatography (Paper, Thin layer, column, gel filtration), GLC, HPLC and FPLC.

#### **Unit V: Molecular Techniques (15 hours)**

Principles and Applications of Radiotherapy. PCR, Electrophoresis AGE and PAGE; X-Ray diffraction; Centrifugation; Ultracentrifugation; Dialysis, Ultrafiltration; Lyophilization and immobilization.

#### **TEXT BOOKS:**

1. Dubey, R.C. and Maheshwari, D.K., *A Text Book of Microbiology*, Revised Edition, S. Chand & Company Ltd., New Delhi, 2010.
2. Prescott, L.M., Harvey, J.P. and Klein, D.A., *Microbiology*, Ninth Edition, Wm. C. Brown Publications, Iowa, 2015.
3. Talaro K. P. and Talaro A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College Dimensi, 2006
4. Tortora, J.G., Funke, R.B. and Case, C.L., *Microbiology: An Introduction*, Twelfth Edition, Pearson Education. Inc., San Francisco, 2016.

#### **REFERENCE BOOKS:**

1. Berg J. M., Tymoczko J. L. and Stryer, L, *Biochemistry* 6th Ed. W.H. Freeman and Company, New York, 2007.
2. Nelson D. and Cox M. M. *Principles of Biochemistry* 5th Ed. W.H. Freeman and Company, New York, 2009.
3. Potter G. W. H. and Potter G. W. *Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques*, Kluwer Academic Publishers, 1995.
4. Willey J., Sherwood L. and Woolverton C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill, 2007.
5. Wilson K. and Walker J. *Principles and Techniques of Biochemistry and Molecular Biology*. 6<sup>th</sup> edition. Cambridge University Press, 2008.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Explain the fundamental concepts of the different types of microscope.         | 1              | Understanding   |
| CO-2   | Substantiate the various principles and methods of sterilization.              | 2              | Applying        |
| CO-3   | Appraise the basic principles and methods of media preparation.                | 5              | Analysing       |
| CO-4   | Evaluate the unknown compound by using Chromatography and Spectrophotometry.   | 3, 4           | Evaluating      |
| CO-5   | Revise the knowledge of biomolecules quantification by electrophoresis method. | 3, 4           | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course        | Hours | Credit |      |                                    |      |      |      |      |
|---|------------------------------------|----------------------------|-------|--------|------|------------------------------------|------|------|------|------|
| I   | 21PCMB12                           | TECHNIQUES IN MICROBIOLOGY | 75    | 4      |      |                                    |      |      |      |      |
| Course Outcomes (COS)                             | Programme Learning Outcomes (PLOs) |                            |       |        |      | Programme Specific Outcomes (PSOs) |      |      |      |      |
|   | PLO 1                              | PLO2                       | PLO3  | PLO4   | PLO5 | PSO1                               | PSO2 | PSO3 | PSO4 | PSO5 |
| CO-1  | ✓                                  | ✓                          | ✓     | ✓      | ✓    |                                    | ✓    |      | ✓    | ✓    |
| CO-2  | ✓                                  | ✓                          |       | ✓      | ✓    | ✓                                  | ✓    |      |      | ✓    |
| CO-3  | ✓                                  | ✓                          |       |        | ✓    | ✓                                  |      | ✓    | ✓    | ✓    |
| CO-4  |                                    | ✓                          |       | ✓      | ✓    | ✓                                  | ✓    |      | ✓    | ✓    |
| CO-5  | ✓                                  | ✓                          |       | ✓      | ✓    |                                    | ✓    | ✓    | ✓    | ✓    |
| Number of matches (✓) = 37<br>Relationship = High |                                    |                            |       |        |      |                                    |      |      |      |      |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – I

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>MICROBIAL DIVERSITY AND CLASSIFICATION</b> |
| Total Hrs           | 75  |
| Hrs/Week            | 5   |
| Sub.Code            | 21PCMB13                                      |
| Course Type         | DSC 3   |
| Credits             | 4   |
| Marks               | 100   |

### General Objective:

The course creates knowledge on number of different species of microbes present in their distribution, morphology and functions of microorganisms.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Review the fundamental concepts of microbial diversity.                                     |
| CO-2          | Infer the modern trends in the classification of microbes.                                  |
| CO-3          | Classify the morphology and ultra-structure of Algae, Fungi and Protozoa.                   |
| CO-4          | Categorize the classification, characteristics and applications of Archae and Eubacteria.   |
| CO-5          | Construct the knowledge of the general characters and classification of Space Microbiology. |

### Unit I: Phycology (15 hours)

General characteristics, thallus structure and life cycle of algae; Classification: by Fritsch (1945) and Lee (2009). Cyanophyceae (Nostoc), Chlorophyceae (Volvox), Xanthophyceae (Vaucheria), Bacillariophyceae (Pinnularia), Phaeophyceae (Sargassum), Rhodophyceae (Polysiphonia); Environmental as well as commercial applications of algae. Algal culture: isolation, cultivation, maintenance and preservation of micro- and macro-algae.

### Unit II: Mycology (15hours)

General characteristics, principles of classification of Alexopoulos (1962) - Major Groups of Fungi - Chytridiomycota (chytrids), Zygomycota (bread molds), Ascomycota (yeasts and sac fungi) and Basidiomycota (club fungi), Deuteromycetes (Fungi imperfect) Fungal reproduction, Spore forms; fungal physiology, nutrition, and growth. Ultrastructure of fungal cell and composition. Genetics and Cell cycle in yeast. Environmental as well as commercial applications of fungi.

### **Unit III: Parasitology (15 hours)**

Characteristics, Morphology and lifecycle; Classification of Protozoa by Hyman and Hickman. Based On Locomotion - Amoeboids (Sarcodina), Flagellates (Mastigophora), Ciliates (Ciliophora), Sporozoa; Branches of Protozoology - Soil Protozoology (Characteristics of Soil Protozoa), Medical Protozoology (Parasitic Protozoa) and Veterinary Protozoology.

### **Unit IV: Archaeobacteria (15 hours)**

Classification, Characteristics and Applications of Archae - Thermophiles: (*Thermococcus*). Methanogens: (*Methanobacterium*, *Methanomicrobium*); Alkalophiles and Acidophiles (*Acidobacteria*, *Acetobacter*): Classification, alkaline environment (soda lakes), life at low pH, acidotolerance, Halophiles (*Halobacterium*, *Chromohalobacter*) - Barophiles (*Halomonas*, *Moritella*): Adaptations of Archaeal cell walls and membranes, commercial aspects and applications of extremozymes.

### **Unit V: Space Microbiology (15 hours)**

Space Microbiology: Aims and objectives of Space research. Microbiological studies in the space environment or using facilities simulating conditions of outer space, Role of Gravity in Basic Biological Processes, Interactions of Microgravity and Radiation in Microorganisms. Survival of Microorganisms in Outer Space; Microorganisms in the spacecraft environment. Antarctica as a model for Mars. Search for life on Mars, Monitoring of astronauts microbial flora.

### **TEXT BOOKS:**

1. Dubey, R.C. and Maheshwari, D.K., *A Text Book of Microbiology*, Revised Edition, S. Chand and Company Ltd., New Delhi, 2010.
2. Dubey. H.C. *A text book of Fungi, Bacteria and virus*, Agrabios India, 2007.
3. Mehrotra R.S. and Ashok Agarwal. *Plant Pathology*, Revised Edition, McGraw Hill publishing company, New Delhi, 2017.

### **REFERENCE BOOKS:**

1. Gerald R. Taylor., *Space Microbiology*, Life Sciences Directorate, LB. Johnson Space Centre. Houston, Texas, 1974.
2. Prescott, L.M., Harvey, J.P. and Klein, D.A., *Microbiology*, Ninth Edition, Wm. C. Brown Publications, Iowa, 2015.
3. Talaro K. P. and Talaro A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College Dimensi, 2006.
4. Tortora, J.G., Funke, R.B. and Case, C.L., *Microbiology: An Introduction*, Twelfth Edition, Pearson Education. Inc., San Francisco, 2016.
5. Willey J., Sherwood L. and Woolverton C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill. 2007.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Summarize the concepts of Microbial classification.  | 1,2            | Understanding   |
| CO-2   | Illustrate the economic importance of algae, cultivation & maintenance of algae.                   | 3,4            | Applying        |
| CO-3   | Categorize the true fungi, habit, habitat and their adaptive strategies.                           | 1,5            | Analyzing       |
| CO-4   | Construct the Parasitology, biological relationship and types of parasitism.                       | 1,4            | Evaluating      |
| CO-5   | Compare the structural similarities and differences among the bacteria/archaea and space microbes. | 2              | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course                    |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I   | 21PCMB13                           | MICROBIAL DIVERSITY AND CLASSIFICATION |       |       |       |                                    | 75    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2                                  | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |  | ✓     | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |
| CO-2  | ✓                                  | ✓                                      |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-3  | ✓                                  | ✓                                      |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4  |                                    | ✓                                      |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5  | ✓                                  | ✓                                      |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| Number of matches (✓) = 38<br>Relationship = High |                                    |  |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – I

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>AGRICULTURAL , ENVIRONMENTAL AND MARINE MICROBIOLOGY</b> |
| <b>Total Hrs</b>    | 60  |
| <b>Hrs/Week</b>     | 4   |
| <b>Sub.Code</b>     | 21PEMB11A   |
| <b>Course Type</b>  | DSE1  |
| <b>Credits</b>      | 4   |
| <b>Marks</b>        | 100   |

### General Objective:

The course creates curiosity about plant diseases, Aero, Aquatic Microbiology and disposal of wastes by providing the fundamental knowledge on Agricultural, Environmental and Marine Microbiology.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Summarize the characteristics of soil and biogeochemical cycle. |
| CO-2          | Relate the microbial interaction and diseases of plants.        |
| CO-3          | Classify the microbes in Air and Aquatic Microbiology.          |
| CO-4          | Manage the use of the benefits of Marine Microbiology.          |
| CO-5          | Score the knowledge in the marine bio resources.                |

### Unit: I Characteristics of Soil and Nitrogen Cycle (12 hours)

Soil – Nature medium for Plant growth, Physical and Chemical Properties of Soil, Soil Structure, Soil Microorganisms-Bacteria, Actinomycetes, Fungi, Algae, Protozoa. Methods used in Soil Microbiological Studies. Biological Nitrogen fixation- Nitrogen Bacteria (Free living and Symbiotic) - mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen fixation - Rhizobium-Legume Association - Nitrogen fixation by non-leguminous plants. Mycorrhizae- Ecto, Endomycorrhizae, Arbuscular Mycorrhizae.

### Unit II: Microbial Interaction and Diseases of Plants (12 hours)

Microbial Interaction: Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation- (rhizosphere, rumen, lichens, mycorrhiza, bioluminescence) Microbe-Plant Interactions (Phyllosphere leguminous plant-*Rhizobium*); VAM. Mechanism of pathogenesis, symptoms and control measures of the following plant



diseases- red rot of sugar cane, late blight of potato, bunchy top of banana and little leaf of brinjal. Management of plant diseases.

### **Unit III: Air and Aquatic Microbiology (12 hours)**

Aerobiology: Composition of air- aerial environment – microbial propagules in air- Indoor and Outdoor flora of air. Seasonal and diurnal periodicities of air. Air sampling techniques: Settle plate method - Anderson sampler and impingers. Significance of air flora. Aquatic Microbiology: Detection of water borne pathogens - sewers swab method - membrane filter techniques - multiple tube fermentation test. Sewage and effluent treatment: Physical, chemical and biological treatment process of sewage. Disposal of treated sewage: Irrigation, composting and land filling. DO, BOD and COD. Impact of eutrophication.

### **Unit IV: Marine Microbiology (12 hours)**

Milestones in Marine Microbiology, Classification of Marine Environment, Properties of seawater. Microbes in the Marine Environment, Marine Actinobacteria: origin, Distribution, Role and importance in the Marine Environment. Marine microbial habitats: Deep Sea, hydrothermal vents, Estuaries, Mangroves, Salt marshes, Beach, coastal ecosystems and coral reefs. Culture-based methods for isolation and identification of microbes: Enrichment culture, Phenotypic testing, Analysis of microbial components. Novel Bioreactors for Culturing Marine Organisms.

### **Unit V: Marine Bioresources (12 hours)**

Marine Bioresources: Marine microbes as Food and Biomedical sources, Fishery products-Fish meal and Fish oil. Phycocolloides: Agar Agar, Algin. Dinoflagellates as sources of bioactive molecules. Chemistry and Pharmacology of marine toxins - Saxitoxin, Tetrodotoxin. Bioremediation Survival at extreme environments. Microbial consortia and genetically engineered microbes in bioremediation of polluted marine sites - heavy metals and crude oil. Biofouling and their control.

### **TEXT BOOKS:**

1. Mitchell R and Kirchman DL. *Microbial Ecology of the Oceans*, Wiley Blackwell Publishers, 1982.
2. Munn C. *Marine Microbiology: ecology and applications*, Garland Science, Taylor and Francis group, NY, 2011.
3. Prescott LM, Harley JP. Klein, *Microbiology*, WCB, Mc Grow Hill Publications, 1999.

4. Raina M. Maier, Ian L. Pepper, Charles, P. Gerba. *Environmental Microbiology*, Academic press, 2006.
5. Stephen J. Jordan,. *Estuaries Classification, Ecology and Human impacts*. Nova Science Publishers, Inc. New York, 2011.

**REFERENCE BOOKS:**

1. Atlas,R.M., and Bartha.M. *Microbial Ecology –Fundamentals and applications*. Benjamin – Cummings, Mento Park, California, 2003.
2. Martin Alexander. *Introduction to Soil Microbiology*, Wiley eastern Ltd., New Delhi, 1983.
- 3.Se-Kwon Kim,. *Marine Microbiology Bioactive Compounds and Biotechnological Applications*. Wiley-VCH Verlag GmbH & Co. KGaA, Boschstr.12, 69469 Weinheim, Germany, 2013.
4. Shiva Aithal, C. *Modern approaches in Soil, Agricultural and Environmental Microbiology*. Himalaya Publishers, New Delhi, 2010.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>  | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|---|-----------------------|------------------------|
| CO-1          | Predict the fundamental concepts of Agricultural Microbiology.                | 1                     | Understanding          |
| CO-2          | Illustrate skills in the management of plant diseases.                        | 2,3                   | Applying               |
| CO-3          | Appraise the fundamental concepts, composition of air and aerial environment. | 1,5                   | Analysing              |
| CO-4          | Design the water borne pathogens and waste water treatment.                   | 2,4                   | Evaluating             |
| CO-5          | Write the general characters and classification of marine environment.        | 2,4                   | Creating               |

### Relationship Matrix

| Semester              | Course Code                                       | Title of the Course                                       |       |       |       |                                    | Hours | Credit |       |       |
|-----------------------|---|---|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I                     | 21PEMB11A   | AGRICULTURAL,<br>ENVIRONMENTAL AND<br>MARINE MICROBIOLOGY |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)                |   |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|                       | PLO 1   | PLO 2   | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1                  | ✓   |   | ✓     | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |
| CO-2                  | ✓   | ✓   |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |
| CO-3                  | ✓   | ✓   |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4                  |   | ✓   | ✓     |       | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5                  | ✓   | ✓   |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
|                       | Number of matches (✓) = 37<br>Relationship = High |   |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – I

|              |                              |
|--------------|------------------------------|
| Course Title | <b>ADVANCED MICROBIOLOGY</b> |
| Total Hrs    | 60                           |
| Hrs/Week     | 4                            |
| Sub.Code     | 21PEMB11B                    |
| Course Type  | DSE                          |
| Credits      | 4                            |
| Marks        | 100                          |

### General Objective

Acquired skills and an initial understanding of recent developments of host-microbe interactions, synthetic biology, viable but non-culturable forms of microorganism.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives   |
|--------|---|
| CO-1   | Understand the salient characteristics of genomes of representative microorganisms. |
| CO-2   | Interpret the concept and importance of metagenomics.                               |
| CO-3   | Analyze the molecular basis of host-Microbe interaction                             |
| CO-4   | Evaluate the systems and synthetic biology of microorganisms.                       |
| CO-5   | Create an awareness about microbiomes and importance of microbial communities.      |

### Unit I: Evolution of Microbial Genomes (12 hours)

Evolution of Microbial Genomes: Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics

### Unit II: Metagenomics (12 hours)

Metagenomics: Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using Metagenomics Basic knowledge of viral metagenome, meta transcriptomics, metaproteomics and metabolomics.

### Unit III: Molecular Basis of Host-Microbe Interaction (12 hours)

Molecular Basis of Host-Microbe Interaction: Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of

microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance.

#### **Unit IV: Synthetic Biology (12 hours)**

Systems and Synthetic Biology: Networking in biological systems, Quorum sensing in bacteria, Coordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses

#### **Unit V: Microbiomes (12 hours)**

Microbiomes and importance of microbial communities, VBNC (viable but not culturable bacteria). Genetically modified organisms and their uses. Modern methods of rapid identification of microbes (PCR, mass spectrometry, fluorescence based techniques). CRISPR-Cas system.

#### **REFERENCE BOOKS**

1. Dubey, R. C. A - Text Book of Biotechnology (4 th Edition) S.Chand & Company Limited, New Delhi.
2. Gupta, P.K. Elements of Biotechnology. Rastogi Publications, Meerut.
3. Jogdand, S. N . Gene Biotechnology (5th Edition ) Himalaya Publishing House

#### **Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>                                 | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Predict the fundamental concepts of microbial genomes  | 1                     | Understanding          |
| CO-2          | Illustrate skills in the metagenomic approach          | 2,3                   | Applying               |
| CO-3          | Develop the host microbe interaction.                  | 4                     | Creating               |
| CO-4          | Determine the synthetic biology networking             | 1                     | Evaluating             |
| CO-5          | Write the general characters of microbial communities. | 2,4                   | Creating               |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course   |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|-----------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I   | 21PEMB11B                          | ADVANCED MICROBIOLOGY |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                       |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2                 | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |                       | ✓     | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |
| CO-2  | ✓                                  | ✓                     |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |
| CO-3  | ✓                                  | ✓                     |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4  |                                    | ✓                     | ✓     |       | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5  | ✓                                  | ✓                     |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| Number of matches (✓) = 37<br>Relationship = High |                                    |                       |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – I

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>BIOETHICS, BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PEMB11C  |
| Course Type         | DSE  |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

To adhere to the ethical practices appropriate to the discipline at all times and to adopt safe working practices relevant to the bioindustries & field of research.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives   |
|--------|---|
| CO-1   | Understand the Bioethics, Biosafety and Intellectual Property Rights in Microbiology.             |
| CO-2   | Interpret the Intellectual Property Rights (IPRs) to take measure for the protecting their ideas. |
| CO-3   | Analyze the devise business strategies by taking account of IPRs.                                 |
| CO-4   | Evaluate to assists in technology upgradation and enhancing competitiveness.                      |
| CO-5   | Create the more advanced insights into the regulatory affairs.                                    |

### UNIT I: Introduction to Bioethics (12 hours)

Introduction to Bioethics. Social and ethical issues in Microbiology. Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues. Use of genetically modified organisms and their release in to the environment. Special procedures for r-DNA based products, Transgenic plants and Animals.

### UNIT II: Regulatory Affairs (12 hours)

Regulatory Affairs: Regulation, national and international guidelines of Biosafety, rDNA guidelines, Regulatory requirements for drugs and Biologics GLP and GMP.

### UNIT III: Intellectual Property Rights (12 hours)

Intellectual Property Rights : Intellectual property rights and protection, patents and methods of application of patents, Trade Secrets

copyrights, Trade Marks, legal implications, farmer's rights, plant breeder's rights. International and National conventions on biotechnology and related areas, WTO guidelines.

#### **UNIT IV: Responsibilities and Rights (12 hours)**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights.

#### **UNIT V: Global Issues (12 hours)**

Global Issues : Multinational corporations - Environmental ethics - computer ethics - weapons development and bioterrorisms - engineers as managers consulting engineers - engineers as expert witnesses and advisors - moral leadership-sample code of Ethics.

#### **TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

#### **REFERENCEBOOKS:**

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993. 7. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001. 9. Singh K. "Intellectual Property Rights on Biotechnology", BCIL, New Delhi.



### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Analyze the Social and ethical issues.   | 1              | Analyzing       |
| CO-2   | Infer the modern regulation, national and international guidelines of Biosafety. | 3              | Understanding   |
| CO-3   | Determine the International and National conventions on Microbiology.            | 1              | Evaluating      |
| CO-4   | Classify and assess the safety and risk  | 4              | Analyzing       |
| CO-5   | Develop the knowledge of the Global Issues.                                      | 4              | Creating        |

### Relationship Matrix

| Semester              | Course Code                        | Title of the Course  |       |       |       |                                    | Hours | Credit |       |       |
|-----------------------|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I                     | 21PEMB11C                          | <b>BIOETHICS, BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS</b> |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|                       | PLO 1                              | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PS O 1                             | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1                  | ✓                                  |  | ✓     | ✓     |       | ✓                                  |       | ✓      |       | ✓     |
| CO-2                  | ✓                                  | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-3                  | ✓                                  | ✓  |       |       | ✓     |                                    | ✓     |        | ✓     |       |
| CO-4                  |                                    | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-5                  | ✓                                  | ✓  |       | ✓     | ✓     |                                    |       | ✓      | ✓     | ✓     |
|                       |                                    | Number of matches (✓) = 35                                   |       |       |       |                                    |       |        |       |       |
|                       |                                    | Relationship = High  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Suriya Prabha  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER – I

| <b>Course Title</b> | <b>TECHNIQUES IN BACTERIOLOGY</b> |
|---------------------|-----------------------------------|
| Total Hrs           | 60                                |
| Hrs/Week            | 4                                 |
| Sub.Code            | 21PCMB1P1                         |
| Course Type         | DSCP I                            |
| Credits             | 2                                 |
| Marks               | 100                               |

### **General Objective:**

The courses describe the practical knowledge on general concepts of aseptic techniques used in laboratory preparation and analyze the classification of bacteria based on morphological and cultural characteristics.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Discuss essentials of laboratory precautions.                               |
| CO-2          | Demonstrate the different sterilization techniques.                         |
| CO-3          | Categorize the staining, motility and pure culture techniques.              |
| CO-4          | Organize the various maintenance activities and preservation of techniques. |
| CO-5          | Assess Fungi isolation and cultivation.                                     |

1. a) Laboratory Precautions.
  - b) Washing and cleaning of glass wares.
  - c) Biological safety cabinets.
2. Hay mount to show different types of microbes.
3. Motility Test (Hanging drop and Soft agar).
4. Staining techniques:
  - a) Gram's staining
  - b) Acid fast staining
  - c) Spore staining
  - d) Capsule staining.
5. Preparation of culture media.
6. Techniques for pure culture of microorganisms by serial dilution technique.
7. Determination of bacterial numbers:
  - a) Pour plate method
  - b) Spread plate method

- c) Streak plate method
- d) Enumeration of bacteria – water and soil samples.
- 8. Counting Microbial cells using Haemocytometer.
- 9. Maintenance and preservation of bacteria (Mineral oil, Lyophilisation)
- 10. Cultivation of anaerobic microorganisms – Pyrogallol method.
- 11. Cultivation and morphology of molds – Lacto phenol cotton blue staining.
- 12. Fungal slide culture technique.

**REFERENCE BOOKS:**

1. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited, 2014.
2. Gunasekaran. P. *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi, 1996.
3. Jayaraman, J. *Laboratory Manual in Biochemistry*. Wiley Eastern Ltd., New Delhi, 1985.
4. Kannan.N.. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani, 1995.
5. Rajan.S., and Selvi Christy. R. *Experimental procedure in Life sciences*. Anjanaa Book House, 2012.
6. Sundararaj, T. *Microbiology – Laboratory Manual*. (First Edition) Publ. Chennai, 2005.

**Course Outcomes**

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Identify the microorganisms based on their morphological and biochemical reactions. | 1,2            | Understanding   |
| CO-2   | Examine the unknown microorganisms from different types of samples.                 | 2,4            | Applying        |
| CO-3   | Differentiate the basic principles and methods of media preparation.                | 3,5            | Analysing       |
| CO-4   | Justify the different techniques of pure culture.                                   | 4              | Evaluating      |
| CO-5   | Evaluate the concepts of cultivation and morphology of molds.                       | 3,4            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course   | Hours | Credit |       |                                    |       |       |       |       |
|---|------------------------------------|---|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| I   | 21PCMB1P1                          | <b>TECHNIQUES IN<br/>MICROBIAL DIVERSITY<br/>AND BACTERIOLOGY</b> | 4     | 2      |       |                                    |       |       |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |   |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|   | PLO 1                              | PLO 2   | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |   | ✓     | ✓      | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-2  |                                    | ✓   | ✓     |        | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| CO-3  | ✓                                  | ✓   |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-4  | ✓                                  |   | ✓     | ✓      | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-5  |                                    | ✓   | ✓     |        | ✓     | ✓                                  | ✓     | ✓     |       | ✓     |
| Number of matches (✓) = 40<br>Relationship = High |                                    |   |       |        |       |                                    |       |       |       |       |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – I

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>TECHNIQUES IN AGRICULTURAL, ENVIRONMENTAL AND MARINE MICROBIOLOGY</b> |
| <b>Total Hrs</b>    | 60   |
| <b>Hrs/Week</b>     | 4  |
| <b>Sub.Code</b>     | 21PCMB1P2  |
| <b>Course Type</b>  | DSCP II  |
| <b>Credits</b>      | 2  |
| <b>Marks</b>        | 100  |

### General Objective:

The course strengthens the practical knowledge on sample collection, isolation, identification and enumeration of microorganisms from various environments besides characterizing the plant associated beneficial, pathogenic and aquatic microbes.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>   |
|---------------|--|
| CO-1          | Identify microbial population from various samples.                    |
| CO-2          | Practice to isolate the <i>Rhizobium</i> species from root nodules.    |
| CO-3          | Analyse the amount of BOD and COD in water samples.                    |
| CO-4          | Collect <i>Vibrio</i> sp and <i>Aeromonas</i> sp from marine products. |
| CO-5          | Value the quality of water and air.                                    |

1. Enumeration of microbial population in soil-bacteria, fungi, actinomycetes.
2. Isolation of *Rhizobium* sp from root nodules of leguminous plants.
3. Isolation of *Azotobacter* sp, *Azospirillum* sp from soil.
4. Isolation of bacterial pathogen and fungal pathogen from diseased plant parts.
5. Determination of BOD.
6. Determination of COD.
7. Enumeration of faecal and total coliform by MPN technique.
8. Enumeration of Microorganisms in water sample by Membrane filter technique.
9. Enumeration of Microorganisms using Open plate and Air Sampler Method.
10. Isolation and identification of Luminescent bacteria from marine fish.
11. Isolation and enumeration of *Vibrio* sp and *Aeromonas* sp from marine products.

**REFERENCE BOOKS:**

1. Aneja, K.R. *Experiments in Microbiology Plant pathology and Biotechnology*, Fourth edition, New age international (p) Limited, Publishers, 2002.
2. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited, 2014.
3. Dubey R.C. and Maheswari. *Practical Microbiology* S. Chand & Co. Ltd., New Delhi, 2002.
4. Kannan. N. *Laboratory Manual in General Microbiology*. Palani Paramount Publication, Palani, 1996.
5. Mitchell R and Kirchman DL. *Microbial Ecology of the Oceans*, Wiley Blackwell Publishers. 1982.
6. Munn C. *Marine Microbiology: ecology and applications*, Garland Science, Taylor and Francis group, NY. 2011.
7. Sundaraj, T. AswathySundararaj, *Microbiology laboratory manual* Chennai, 2002.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>  | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|---|-----------------------|------------------------|
| CO-1          | Recognize soil and nature medium for plant growth.                | 1,4                   | Understanding          |
| CO-2          | Examine the different types of <i>Mycorrhizae</i> .               | 1,2                   | Applying               |
| CO-3          | Analyze the quality of air and water.                             | 4,5                   | Analyzing              |
| CO-4          | Compare different types of bacteria in marine products.           | 1,3                   | Evaluating             |
| CO-5          | Design skills on isolation and identification of plant pathogens. | 3,4                   | Creating               |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course  | Hours | Credit |       |                                    |       |       |       |       |
|--|------------------------------------|--|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| I  | 21PCMB1P<br>2                      | TECHNIQUES IN<br>AGRICULTURAL,<br>ENVIRONMENTAL AND MARINE<br>MICROBIOLOGY | 60    | 2      |       |                                    |       |       |       |       |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |  |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|  | PLO 1                              | PLO 2  | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1   | ✓                                  |  | ✓     | ✓      | ✓     | ✓                                  |       |       | ✓     | ✓     |
| CO-2   |                                    | ✓  | ✓     |        | ✓     |                                    | ✓     | ✓     |       | ✓     |
| CO-3   |                                    | ✓  | ✓     | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-4   | ✓                                  |  | ✓     | ✓      | ✓     | ✓                                  | ✓     | ✓     | ✓     | ✓     |
| CO-5   | ✓                                  | ✓  | ✓     |        | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| Number of matches (✓) =38<br>Relationship = High |                                    |  |       |        |       |                                    |       |       |       |       |

Prepared by  
Dr. K. Feroz Khan  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER – I

|                     |                                      |
|---------------------|--------------------------------------|
| <b>Course Title</b> | <b>MICROBIOLOGY AND HUMAN HEALTH</b> |
| Total Hrs           | 40                                   |
| Hrs/Week            | 2                                    |
| Sub.Code            | 21PIMB11                             |
| Course Type         | IDC-1                                |
| Credits             | 2                                    |
| Marks               | 100                                  |

### General Objective:

The course introduces the normal flora, its benefits, pathogens, transmission, diagnosis, treatment and preventive measures.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Report about significance of public health.                         |
| CO-2          | Demonstrate the diseases caused by Bacteria.                        |
| CO-3          | Categorize the knowledge in important human Viral, Fungal diseases. |
| CO-4          | Organize to know about the Bacterial and Viral vaccines.            |
| CO-5          | Assess the knowledge of human Protozoan diseases.                   |

### Unit I: Normal Flora (8 hours)

Introduction to public health: definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health. Normal flora of human body, Role of the resident flora. Brief account of major air, water and food borne diseases of microbial origin and their preventive and control measures.

### Unit II: Bacteriology (8 hours)

Introduction - major human bacterial diseases, transmission, diagnosis and treatment: caused by *Staphylococcus*, *Streptococcus*, *Neisseria*, *Bacillus*, *Corynebacterium*, *Clostridium*, *Pseudomonas*, *Yersinia*, *Haemophilus*, *Mycobacterium*, Antibacterial agents and susceptibility test, Bacterial vaccines.



### **Unit III: Virology (8 hours)**

Introduction - major human viral diseases, transmission, diagnosis and treatment: **Coronavirus**, Mumps, Measles, Influenza, Enterovirus, Rhinovirus, Poxvirus, Hepatitis virus; Herpesvirus, AIDS, Antiviral drugs, viral vaccines.

### **Unit IV: Mycology (8 hours)**

Introduction – major human fungal diseases transmission, diagnosis and treatment: Candidiasis, Dermatophytosis, Aspergillosis, Cutaneous and subcutaneous mycoses, Systemic mycoses, Opportunistic mycoses, Antifungal agents.

### **Unit V: Parasitology (8 hours)**

Introduction – major human Protozoal diseases, transmission, diagnosis and treatment: Entamoeba, Giardia, Trichomonas. Blood and tissue protozoa; Plasmodium, Trypanosoma, Leishmania, Taenia, Schistosoma, Nematodes: Ascaris, Filariasis, , antiparasitic agents.

### **TEXT BOOKS:**

1. Atlas R. M. *Principles of Microbiology*, II Ed., McGraw Hill, 1997.
2. Ghimire P. and Parajuli K. *A Text Book of Microbiology*, Vidhyarthi Pustak Bhandar Publication, Kathmandu, 2005.
3. Parija. *Textbook of Microbiology and Immunology*. ELSEVIER, ISBN: 978-81-312-2810-4., 2012.
4. Talaro K. P. and Talaro A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College. Dimensi,2006.
5. Willey J., Sherwood L. and Woolverton C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill, 2007.

### **REFERENCE BOOKS:**

1. Brownson, R.C., Baker, E.A., Leet T.L. and Follespie K.N. *Evidence Based Public Health*, Oxford University Press, 2003.
2. Greenwood D. *Medical Microbiology*, 4th Ed., I.K. International, 2007.
3. Harvey, R.A., Champe, P.C. and Fisher, B.D. *Lippincott's Illustrated Reviews: Microbiology*,2007.
4. Nester E. W., Anderson D. G. and Nester M. T. *Microbiology: A Human Perspective*, McGrawHill,2006.
5. Willey J., Sherwood L. and Woolverton C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill, 2007.
6. Engelkirk P.G. and Duben-Engelkirk J. Burton's. *Microbiology for the Health Sciences*, 10<sup>th</sup> Edn. Wolters Kluwer Health, 2015.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Identify the fundamental concepts of public health.                                | 1,5            | Understanding   |
| CO-2   | Schedule the human diseases caused by bacterial pathogens and disease management.  | 1,2            | Applying        |
| CO-3   | Test the basic concepts of human viral diseases and disease management.            | 2,5            | Analysing       |
| CO-4   | Arrange the systemic mycoses, opportunistic mycoses and antifungal agents.         | 4              | Evaluating      |
| CO-5   | Compare the severity of human protozoan diseases, prevention and control measures. | 4,5            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course           |       |       |       |                                    | Hours | Credit |       |       |  |  |
|---|------------------------------------|-------------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| I   | 21PIMB11                           | MICROBIOLOGY AND HUMAN HEALTH |       |       |       |                                    | 40    | 2      |       |       |  |  |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                               |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|   | PLO 1                              | PLO 2                         | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1  | ✓                                  | ✓                             | ✓     | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-2  | ✓                                  | ✓                             |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |  |  |
| CO-3  |                                    | ✓                             | ✓     |       | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-4  |                                    | ✓                             |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-5  | ✓                                  | ✓                             |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |  |  |
| Number of matches (✓) = 37<br>Relationship = High |                                    |                               |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – II

| Course Title | MICROBIAL BIOCHEMISTRY |
|--------------|------------------------|
| Total Hrs    | 75                     |
| Hrs/Week     | 5                      |
| Sub.Code     | 21PCMB21               |
| Course Type  | DSC 4                  |
| Credits      | 4                      |
| Marks        | 100                    |

### General Objective:

The course focuses to understand the basic concept of biochemistry, gain knowledge on various biomolecules and also helps to gather information in enzyme kinetics.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives                                       |
|--------|---|
| CO-1   | Summarize the laws of thermodynamics.                   |
| CO-2   | Interpret the Basic knowledge on Carbohydrates.         |
| CO-3   | Distinguish the classification and chemistry of Lipids. |
| CO-4   | Formulate the structure and properties of proteins.     |
| CO-5   | Score knowledge in Different forms DNA and RNA.         |

### UNIT I: Carbohydrates (15 hours)

Chemistry of Life: Evolution of organisms-atom structure - chemical bonds- water structure and properties - laws of thermodynamics. Classification- Properties- Optical and Chemical Structure of Glucose, Ring structure, Haworth and Fischer's projection, Pyranose, Furanose Isomers. Mutarotation, Triose, Pentose, Hexose, Heptose - Example and Structures, Derived Monosaccharide - Glycosides, Furanoacids, Sugar, Uronic acids, Sugar alcohol, Disaccharides- Glycosidic linkage, Lactose, Maltose, Sucrose, Oligosaccharide, Trisaccharides, Structure of raffinose- Polysaccharide- Homopolysaccharide, Heteropolysaccharide Structure, Starch, Cellulose, Mucopolysaccharide and Biological Significance.

### UNIT II: Lipids (15 hours)

Classification, Components and Chemistry of Lipids, Fatty acids and Glycerals, Types of Fatty acids: Essential, Non Essential and Unsaturated, Saturated fatty acids, Triglycerides, Saponification, Sterols, Cholesterol, Prostaglandins, Glycolipids, Phospholipids, Lipoproteins and Functions of lipids.

### **UNIT III Proteins (15 hours)**

Classification of amino acids, Properties, Peptide bond, Formation and properties of proteins. Classification, Elemental composition, Structure of Primary, Secondary, Tertiary and Quarternary Protein, Ramachandran plot-domains.

### **UNIT IV: Nucleic acids (15 hours)**

Structure of Nitrogen bases and base pairing, Structure of Nucleosides, Nucleotides, Ribose, Deoxyribose sugar. Components, Types, Tautomeric Forms, Nomenclature & analogs. Different forms, structure and functions of DNA & RNA.

### **UNIT V: Enzymes (15 hours)**

Enzymes- Concept, Definition, Nature, Active site, Properties, Classification, Physico- Chemical properties. Factors affecting the enzyme synthesis and activity. Enzyme kinetics. Allosterism – Determination of Michaelis Menten constant – Factors affecting Km Value – Mode of Enzyme action (Lock and Key model and Induced fit model)- Coenzymes – Cofactors – Isozymes and Inhibitors. Vitamins - Water and fat soluble vitamins and functions.

### **TEXT BOOKS**

1. Jain. J.L. *Fundamental of Biochemistry*, S. Chand & company Ltd, New Delhi, 2012.
2. Kanai L. Mukherjee, *Medical Laboratory Technology – A procedure manual for routine diagnosis tests*, Tata McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III,2014.
3. Palanivelu, P. *Analytical Biochemistry and Separation Techniques*, Second edn, 2001.
4. Santhyanarayana. U. *Essentials of Biochemistry*. (1<sup>st</sup> Edition) Books and Allied Ltd., Kolkata, 2002.

### **REFERENCE BOOKS:**

1. Deb A.C. *Concepts of Biochemistry*. (7<sup>th</sup> Education), Books and Allied (P) Ltd., Kolkata, 1999.
2. Donald Voet and Judith Voet. *Biochemistry*. John Wiley and Sons, New York, 1990.
3. Georges N. Cohen. *Microbial Biochemistry*-2<sup>nd</sup> Edition - Springer, Feb 2, Science, 2011.
4. Lehninger. *Principle of Biochemistry*. 3<sup>rd</sup> editions by Nelson and Cox (Worth), 2009.
5. Stryer, L. *Biochemistry*. Ed. W.H. Freeman and company, New York, 1995.

### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Discuss the fundamental concepts of biomolecules.           | 1,2            | Understanding   |
| CO-2   | Interpret structure, classification and function of lipids. | 3,5            | Applying        |
| CO-3   | Categorize the peptide bond, formation and its types.       | 3,4            | Analyzing       |
| CO-4   | Formulate the structure of nucleosides, nucleotides.        | 2,5            | Evaluating      |
| CO-5   | Measure and determine Michaelis Menton constant.            | 4,5            | Creating        |

### Relationship Matrix

| Semester              | Course Code                                      | Title of the Course    |       | Hours | Credit |                                    |       |       |       |       |
|-----------------------|--|------------------------|-------|-------|--------|------------------------------------|-------|-------|-------|-------|
| II                    | 21PCMB21   | MICROBIAL BIOCHEMISTRY |       | 75    | 4      |                                    |       |       |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)               |                        |       |       |        | Programme Specific Outcomes (PSOs) |       |       |       |       |
|                       | PLO 1  | PLO 2                  | PLO 3 | PLO 4 | PLO 5  | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1                  | ✓  | ✓                      | ✓     | ✓     | ✓      |                                    | ✓     |       | ✓     | ✓     |
| CO-2                  | ✓  | ✓                      |       |       | ✓      | ✓                                  | ✓     |       |       | ✓     |
| CO-3                  | ✓  |                        | ✓     | ✓     | ✓      | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-4                  |  | ✓                      | ✓     | ✓     | ✓      | ✓                                  | ✓     |       |       | ✓     |
| CO-5                  | ✓  | ✓                      | ✓     | ✓     | ✓      |                                    | ✓     | ✓     | ✓     | ✓     |
|                       | Number of matches (✓) =37<br>Relationship = High |                        |       |       |        |                                    |       |       |       |       |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr .R. Janet Rani  
Head of the Department

## SEMESTER – II

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>MICROBIAL PHYSIOLOGY AND METABOLISM</b> |
| Total Hrs           | 75   |
| Hrs/Week            | 5  |
| Sub.Code            | 21PCMB22                                   |
| Course Type         | DSC 5                                      |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

The course creates knowledge on physiology, metabolism, nutritional requirements, microbial photosynthesis and bioluminescence of microorganisms.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                              |
|---------------|---|
| CO-1          | Relate the basic knowledge in Respiratory metabolism. |
| CO-2          | Arrange about Classification of Microbial metabolism. |
| CO-3          | Construct the microbial growth rate.                  |
| CO-4          | Compare types of microbial photosynthesis.            |
| CO-5          | Review the mechanisms of Nutritional uptake.          |

### Unit I: Nutrients uptake of cell (15 hours)

Nutritional requirements of major groups of microbes (bacteria & fungi): Nutritional uptake; transport across the membranes and cell wall (diffusion, passive diffusion, active transport, group translocation iron uptake, Proton Motive Force, and PTS) Role of permeases in transport. Transport of aminoacids, inorganic ions in microorganisms and their mechanisms.

### Unit II: Microbial Respiratory metabolism (15 hours)

Respiratory metabolism: Glycolytic pathway of carbohydrates breakdown, Glycolysis, Embden Meyerhoff pathway, Krebs cycle, Entner-Duodoroff pathway, Phosphoketolase pathway; Pentose phosphate pathway; Electron transport chain; phosphorylation; Oxidative and Substrate level phosphorylation, Gluconeogenesis, Glyoxylate cycle, Fermentation of Carbohydrates, Homo and Hetero Lactic fermentation.

### Unit III: Biosynthesis of essential compounds (15 hours)

Microbial metabolism: Anabolism, Catabolism - Biosynthesis of Essential amino acid, Sulphur metabolism, Biosynthesis of purines and

pyrimidines. Lipid metabolism: Biosynthesis of fatty acids and phospholipids. Beta (palmitic acid), Alpha, omega and peroxisomal oxidation of fatty acids and their energetics. Oxidation of odd chain fatty acids.

#### **Unit IV: Microbial Growth (15 hours)**

Measurement of growth (biomass, turbidity, dry weight and protein content); Physical and Chemical factors affecting microbial growth; control of microbes by Physical and Chemical agents. Microbial Metabolites- Primary and Secondary. Energy from inorganic compounds

#### **Unit V: Photosynthesis (15 hours)**

Introduction : Absorption of light, photosynthetic and accessory pigments (Chlorophyll, Bacteriochlorophyll, Carotenoides, Phycobilliproteins); Oxygenic and Anoxygenic photosynthesis in prokaryotes, Calvin cycle; effect of Light, Temperature, pH and CO<sub>2</sub> on photosynthesis; Photosynthetic yield and Photorespiration. Bioluminescence: mechanism and application.

#### **TEXT BOOKS:**

1. Dubey, R.C. and Maheshwari, D.K. *A Text Book of Microbiology*, Revised Edition, S. Chand & Company Ltd., New Delhi, 2010.
2. Potter G. W. H. and Potter, Geoffrey W. *Analysis of Biological Molecules: An Introduction to Principles, Instrumentation and Techniques*, Kluwer Academic Publishers, 1995.
3. Talaro K. P. and T alaro A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College, 2006.

#### **REFERENCE BOOKS:**

1. Berg J. M., Tymoczko J. L. and Stryer, L. *Biochemistry*, 6th Ed. W.H. Freeman and Company, New York, 2007.
2. Joanne Willey and Kathleen Sandman., *Principles of Microbiology*, II<sup>nd</sup> Ed., McGraw Hill, 2007.
3. Nelson D. and Cox M. M. *Principles of Biochemistry*, 5th Ed. W.H. Freeman and Company, New York, 2009.
4. Willey J., Sherwood L. and Woolverton C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill. 1997.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Summarize the nutritional types, mode of intake of nutrients and metabolic activity of microorganisms. | 2,4            | Understanding   |
| CO-2   | Illustrate the study of photosynthetic yield and photorespiration.                                     | 3,5            | Applying        |
| CO-3   | Relate various theories on microbial metabolism and pathways.  | 1,2            | Analysing       |
| CO-4   | Assemble the biosynthesis of purines and pyrimidines.  | 3,5            | Evaluating      |
| CO-5   | Value the electron transport chain.  | 1,5            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course                 |       |       |       |                                    | Hours | Credit |       |       |  |  |
|---|------------------------------------|-------------------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| II  | 21PCMB22                           | MICROBIAL PHYSIOLOGY AND METABOLISM |       |       |       |                                    | 75    | 4      |       |       |  |  |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                                     |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|   | PLO 1                              | PLO 2                               | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1  | ✓                                  | ✓                                   | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| CO-2  | ✓                                  | ✓                                   |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-3  | ✓                                  |                                     | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-4  |                                    | ✓                                   |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |  |  |
| CO-5  | ✓                                  | ✓                                   | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| Number of matches (✓) = 40<br>Relationship = High |                                    |                                     |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr .R. Janet Rani  
Head of the Department



## SEMESTER – II

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>MOLECULAR BIOLOGY AND GENETIC ENGINEERING</b> |
| Total Hrs           | 75   |
| Hrs/Week            | 5  |
| Sub.Code            | 21PCMB23   |
| Course Type         | DSC 6  |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

The course teaches the concept of genetic materials, molecular mechanism involved in transcription, translation and also helps to understand the significance of genetic engineering.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>   |
|---------------|--|
| CO-1          | Understand the experimental evidences in genetic material.                     |
| CO-2          | Signify central dogma of gene action.  |
| CO-3          | Categorize the molecular mechanisms involved in transcription and translation. |
| CO-4          | Collect the concept of operon mechanism.                                       |
| CO-5          | Score the concepts in genetic engineering.                                     |

### Unit I: Deoxyribonucleic Acid (15 hours)

DNA as Genetic material - Oswald Avery, Colin MacLeod, Maclyn McCarty, Frederick Griffith, Watson and Crick model; DNA; Types of DNA (A, B, Z); Models of DNA replication and experimental evidences - Semi-conservative, Conservative, Dispersive. Various modes of replication - d-loop replication and rolling circle; DNA replication in prokaryotes and eukaryotes - initiation, elongation, termination. Differences between prokaryotic and Eukaryotic DNA replications.

### Unit II: Ribonucleic Acid (15 hours)

RNA types and Structure - mRNA, rRNA, tRNA. Transcription – initiation, elongation & termination. Types of RNA polymerase. Inhibitors of RNA synthesis, Post transcriptional modification (RNA processing) - capping, polyadenylation and splicing – spliceosome, Alternative splicing; Difference between prokaryotic and Eukaryotic transcription; Translation - steps involved, Post translational modification of proteins, inhibitors of translational process. Salient features of genetic code.

### **Unit III: Gene operon (15 hours)**

Regulation of Gene Expression - Transcriptional control- promoters, terminators, attenuators. Regulation of gene expression in prokaryotes; operon concept; positive regulation in *E. coli* (Arabinose operon) and negative regulation in *E. coli* (lac operon), inducers and repressors, regulation by attenuation (trp operon).

### **Unit IV: Genetic Engineering (15 hours)**

Genetic Engineering - Basics of r-DNA technology: Enzymes employed - DNA ligase, DNA polymerase, DNase, Klenow fragment, reverse transcriptase, terminal transcriptase, exonuclease, restriction endonuclease, nuclease, Ribonuclease-H, alkaline phosphatase, polynucleotide kinase and dephosphatases.

### **Unit V: Genetic recombination (15 hours)**

Genetic recombination processes - Conjugation, Transformation, Transduction; Role of rec proteins in homologous recombination. Conjugation - Discovery and Mechanism; F<sup>+</sup>, F<sup>-</sup> and Hfr cells; F<sup>+</sup> and F<sup>-</sup> and Hfr and F<sup>-</sup> genetic crosses. Sexduction (F<sup>-</sup>duction: F<sup>'</sup> x F<sup>-</sup>), conjugational transfer of colicinogenic and resistance transfer factors; Mechanism of Transformation; Transduction - mechanism and types - generalized, specialized and lateral.

### **TEXT BOOKS**

1. Gupta. PK *A text book of Molecular biology*, Rastogi Publication, 2018.
2. Kishore R. Pawar, Ashok E. Desai, B. M. Deore., *A Book of Genetics and Molecular biology*, Revised Edition, Nirali Prakashan Publication Ltd., New Delhi, 2010.
3. Lizabeth A. Allison. *Fundamental Molecular biology*, Revised Edition, Blackwell publishing company, Austria, 2007.

### **REFERENCE BOOKS:**

1. Brown T.A. *Gene Cloning*. Blackwell Publishing, 2006.
2. Harvey Lodish , Arnold Berk , Chris A. Kaiser, Monty Krieger, , Hidde Ploegh, Angelika Amon, Matthew P. Scott. *Molecular Cell Biology*, Recent edition, WH Freeman publishers, 2005.
3. Lewin. Gene VII. Oxford University Press, 2000.
4. Nicholl D. S. T. *An Introduction to Genetic Engineering*, Cambridge University Press, 2008.
5. Old and Primrose. *Principles of Gene Manipulation*. Blackwell Scientific Publication, 2001.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Discuss molecular cell biology.  | 1,4            | Understanding   |
| CO-2   | Relate the structure and function of DNA and RNA.                        | 1,2            | Applying        |
| CO-3   | Solve central cell biological processes                                  | 3,5            | Analyzing       |
| CO-4   | Formulate the regulation of operons.                                     | 1,4            | Evaluating      |
| CO-5   | Rate the study of enzymes and application of recombinant DNA technology. | 3,5            | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course                             |       |       |       |                                    | Hours | Credit |       |       |  |  |
|--|------------------------------------|---|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| II   | 21PCMB23                           | MOLECULAR BIOLOGY<br>AND GENETIC<br>ENGINEERING |       |       |       |                                    | 75    | 4      |       |       |  |  |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |   |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|  | PLO 1                              | PLO 2   | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1   | ✓                                  | ✓   | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |  |  |
| CO-2   | ✓                                  |   | ✓     | ✓     | ✓     | ✓                                  | ✓     | ✓      |       | ✓     |  |  |
| CO-3   | ✓                                  | ✓   |       | ✓     | ✓     | ✓                                  |       |        | ✓     | ✓     |  |  |
| CO-4   |                                    | ✓   | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-5   | ✓                                  | ✓   |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| Number of matches (✓) =39<br>Relationship = High |                                    |   |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
Dr. M. Suriya Prabha  
Name and Signature

Checked by  
Dr .R. Janet Ran  
Head of the Department

## SEMESTER – II

|                     |                 |
|---------------------|-----------------|
| <b>Course Title</b> | <b>VIROLOGY</b> |
| Total Hrs           | 60              |
| Hrs/Week            | 4               |
| Sub.Code            | 21PEMB21A       |
| Course Type         | DSE             |
| Credits             | 4               |
| Marks               | 100             |

### General Objective:

The course able to insights on history, development, classification, taxonomy, replication of virus also familiarize with the culture methods and assay of virus.

Course Objectives: The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Discuss the Classification and taxonomy of viruses.                   |
| CO-2          | Demonstrate the methods of Cultivation and Assay of virus.            |
| CO-3          | Distinguish the plant virus classification, transmission and Impacts. |
| CO-4          | Compose knowledge about human and animal viruses.                     |
| CO-5          | Write about different types of vaccines.                              |

### UNIT I: Basics of Virology (15 hours)

History, brief outline and discovery of viruses. Classification and taxonomy of viruses - based on host, nucleic acids and structure; Evolution of Viruses. Bacterial Viruses – taxonomy of bacterial viruses ( $\phi$ X 174; M 13; Lambda and Mu). DNA and RNA containing Viruses – Structure – Replication (Lytic and Lysogeny). Viroids and prions.

### UNIT II: Cultivation of viruses (15 hours)

Growth of viruses in chick embryonated egg, in experimental animals and in cell cultures-primary, secondary, Diploid and continuous cell culture. Susceptible cell lines. Assay of viruses: physical and chemical methods of assay, (protein, nucleic acid, radioactivity tracers, electron microscopy, infectivity assay of animal virus (plaque method, pock counting, end point method) and infectivity assay of plant viruses.

### **UNIT III: Plant viruses (15 hours)**

Plant viruses - Classification, Transmission of Plant Viruses and Viroids (Vegetative Propagules, Seed Pollen Contact and Mechanical, Water, Vectors, Arthropod vectors). Impact of virus and viroid Diseases on Crop Yields (Spice Crops, Bio Fuel Crops, Edible Oil Seed Crops). Tobacco Mosaic viruses (TMV). Cauliflower mosaic virus (CaMV). Cynophages, Mycophages.

### **UNIT IV: Human and Animal Viruses (15 hours)**

Ultra structure of major human and animal viruses: Picorna virus: Polio disease, Herpes virus: Herpes Simplex virus, Human Papiloma virus: Cervical Cancer, Toga virus: Chikungunya, Flavivirus: Dengue fever, Retro virus: HIV. Hepatitis B Animal viruses – SV 40, Adeno viruses, Swine flu, Bird flu, Rota Virus.

### **UNIT: V Control of Viruses and Emerging Viruses (15 hours)**

Strategies of anti-viral agents and viral vaccination. Antiviral chemotherapy and agents: Acyclovir, Ganciclovir, Ribavirin, Zidovudine and Lamirudine. Vaccination: Types, protein and peptides vaccines, DNA vaccines. Emerging viruses: Nipah henipavirus, SARS (Corona), Phage therapy. Biosafety and containment facility in virology lab.

#### **Text Books:**

1. Biswas and Biswas. *An Introduction to Viruses*, 1995.
2. Christopher J. Burrell, Colin R. Howard, Frederick A. Murphy. *Fenner and White's Medical Virology*. Academic Press, 2016.
3. Dimmock, N. J., A. J. Easton, K. N. Leppard. *Introduction to Modern Virology*, 6th ed. Blackwell Scientific Publ, 2007.
4. Khan J.A, J. Dijkstra. *Plant Viruses as molecular pathogens*. CBS publishers and Distributors, New Delhi, 2000.
5. Waginer and M. Hewlett. *Basic Virology*, Blackwell Science Publ, 1999.

#### **Reference Books:**

1. Dimmock N.J, Primrose S.B. *Introduction to Modern Virology*, IV edition. Blackwell Scientific Publications, Oxford, 1994.
2. Fields. B.N. Fields, D.M. Knipe, B. Roizman and S.E. Straus, *Virology* Vol I and II Lippincott-Raven, Philadelphia, PA, 2007.
3. Frankel Conrat et al, *Virology*, 3rd ed. Prentice Hall, 1994.
4. Prescott L.M., Harley J.P. and Klein D.A. *Microbiology* (7th edition). McGraw Hill, New York, 2008.
5. Roger Hull. *Mathew's Plant Virology*, (4th edition). Academic press. A Harcourt Science and Technology company, New York, 2002.
6. Roger Hull. *Plant Virology*, 5th Edition. Academic Press, 2013.

### Course Outcomes

| CO. No. | Upon the completion of the course, the students will be able to:  | PSO addressed | Cognitive level |
|---------|---|---------------|-----------------|
| CO1     | Review the fundamental concepts of Virology.                      | 1,2           | Understanding   |
| CO2     | Interpret the isolation and purification of viruses               | 2,4           | Applying        |
| CO3     | Experiment the quantitative assay and immunodiagnosis of virus.   | 3,4           | Analyzing       |
| CO4     | Manage animal and plant viruses.                                  | 3,5           | Evaluating      |
| CO5     | Revise the Strategies of anti-viral agents and viral vaccination. | 5             | Creating        |

### Relationship Matrix

| Semester              | Course Code                        | Title of the Course |       |       |       |                                    | Hours | Credit |       |       |  |  |
|-----------------------|------------------------------------|---------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| II                    | 21PEMB21A                          | VIROLOGY            |       |       |       |                                    | 60    | 4      |       |       |  |  |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs) |                     |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|                       | PLO 1                              | PLO 2               | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1                  |                                    | ✓                   | ✓     | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |  |  |
| CO-2                  | ✓                                  | ✓                   |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |  |  |
| CO-3                  | ✓                                  | ✓                   | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-4                  |                                    | ✓                   |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     |       |  |  |
| CO-5                  | ✓                                  | ✓                   | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
|                       | Number of matches (✓) =38          |                     |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
Dr. K. Feroz Khan  
Name and Signature

Checked by  
Dr .R. Janet Rani  
Head of the Department

## SEMESTER – II

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>FOOD SAFETY, QUALITY CONTROL AND SENSORY EVALUATION</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PEMB21B  |
| Course Type         | DSE  |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

To introduce the principles, methods of Food Quality Control, assurance, selection of panel lists for sensory evaluation and Quality Management System.

### Course Objectives: The learners will be able to:

| CO No. | Course Objectives   |
|--------|---|
| CO-1   | Understand the principles of Food hazards and HACCP   |
| CO-2   | Interpret the Physical, chemical and biological parameter for food.                           |
| CO-3   | Analyze the Quality and different standards of foods.   |
| CO-4   | Evaluate the food based on sensory evaluation.  |
| CO-5   | Create an awareness sanitation and hygiene in quality assurance in different food industries. |

### UNIT-1: Food safety (12 hours)

Food safety: Characterization and risk analysis- Food hazards: Physical, Chemical and biological systems for food safety. Hazard Analysis Critical Control Point (HACCP) and its implementation.

### UNIT-II: Physico chemical methods for food analysis (12 hours)

Physico chemical methods for food analysis - Moisture and Total solids, Carbohydrates, Proteins, Fats, Fiber, Ash and its types, Minerals, Vitamins. Enzymatic methods. Biological methods of food analysis - Standard plate count; Plate loop method; Spiral plate; Droplet technique; Dye reduction; Catalase test and ELISA. Testing of food for organisms such as *B. cereus*, *C. botulinum*, *E. coli*, *L. monocytogenes*, *S.aureus*, *Salmonella* and *Shigella*.

### UNIT-III: Quality Assurance (12 hours)

Theoretical and practical considerations, description of different systems: GAP, GMP, TQM, ISO. Indian food standards- Voluntary and

Obligatory standards (PFA,FPO,MMPO,AGMARK etc.) Codex alimentarius, Worldwide food safety issues.

#### **UNIT-IV: Sensory evaluation (12 hours)**

Requirements and methods. Sensory parameters: Colour, flavour, texture, taste, aroma, general acceptability. Subjective and Objective test of sensory parameters. (Differential test, Descriptive test, Rating test, Sensitivity threshold test).

#### **UNIT V: Clean In Place (CIP) (12 hours)**

Different sanitizers and detergents- Sanitation and hygiene in quality assurance in different food industries ( Fruits and vegetables, Meat, Milk, Cereal Based).Cost of Quality, Supplier development.

#### **TEXT BOOKS**

1. Amerine MA, Pangborn RM & Rosslos EB. 1965. Principles of Sensory Evaluation of Food. Academic Press.
2. Early R.1995.Guide to Quality Management Systems for Food Industries. Blackie Academic.
3. Furia TE.1980. Regulatory status of Direct Food Additives. CRC Press.
4. Ranganna S. 2001. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw-Hill.
5. Export/Import policy by Govt. of India.

#### **REFERENCE BOOKS:**

1. Jellinek G. 1985. Sensory Evaluation of Food - Theory and Practice. Ellis Horwood.
2. Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol. I, II. AVI Publ.
3. Macrae R, Roloson R & Sadlu MJ. 1994. Encyclopedia of Food Science & Technology & Nutrition. Vol. XVI. Academic Press.
4. Piggot J.R. 1984. Sensory Evaluation of Foods. Elbview Applied Science.



### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Analyze the characterization of food and risk factors.                                       | 1,4            | Analyzing       |
| CO-2   | Infer the modern techniques in food analysis.  | 3,5            | Understanding   |
| CO-3   | Determine the out sensory evaluation of a newly developed product.                           | 1,2            | Evaluating      |
| CO-4   | Classify the sanitation and hygiene in quality assurance in different food industries        | 4,5            | Analyzing       |
| CO-5   | Develop the knowledge in critical control points of different existing production processes. | 4,5            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course  |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| I   | 21PEMB2B                           | <b>FOOD SAFETY, QUALITY CONTROL AND SENSORY EVALUATION</b> |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |  | ✓     | ✓     |       | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-2  | ✓                                  | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-3  | ✓                                  | ✓  |       |       | ✓     | ✓                                  | ✓     |        | ✓     |       |
| CO-4  |                                    | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-5  | ✓                                  | ✓  | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| Number of matches (✓) = 35<br>Relationship = High |                                    |  |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – II

|                     |                                |
|---------------------|--------------------------------|
| <b>Course Title</b> | <b>FERMENTATION TECHNOLOGY</b> |
| Total Hrs           | 60                             |
| Hrs/Week            | 4                              |
| Sub.Code            | 21PEMB2C                       |
| Course Type         | DSE                            |
| Credits             | 4                              |
| Marks               | 100                            |

### **General Objective:**

To introduce the principles of fermentation and various technologies.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the principles and various types of Fermentor                      |
| CO-2          | Interpret the different online monitoring techniques in fermentation process. |
| CO-3          | Analyze the medium formulation in various fermentation                        |
| CO-4          | Evaluate the role of microbes in fermentation products                        |
| CO-5          | Create an awareness in current fermentation technology.                       |

### **UNIT -I: Introduction to fermentation technology (12 hours)**

Fermentation, principle of fermentation, Fermentation –Types, batch ,fed batch , continuous fermentation. Factors that influences fermentation process, advantage and disadvantage of fermentation.

### **UNIT –II: Bioreactors (12 hours)**

Definition of fermentor or bioreactors – Design and construction of fermentor , sterilization of fermentor, Types of fermentors- Air lift fermentor, Continuous stirred tank fermentors, Packed bed fermentors, Bubble column fermentors and Fluidized bed fermenters

### **UNIT-III: Microorganisms used in fermentation technology (12 hours)**

Microorganisms used in fermentation technology , medium used in fermentation technology, Medium formulation,(carbon sources ,energy sources, nitrogen sources, PH, buffers, minerals, water, oxygen requirements, antifoams).

#### **UNIT-IV: Food fermentation (12 hours)**

Definition of food fermentation – microbes used in food fermentation – fermented food products – bread , vinegar, wine , fermented milk products and fermented meat products.

#### **UNIT-V: Application of fermentation technology (12 hours)**

Uses and Application of fermentation technology, Current development of fermentation technology, Fermentation economics.

#### **TEXT BOOKS:**

1. Dubey, R. C. A. *Text Book of Biotechnology*. (4<sup>th</sup> Edition) S. Chand & Company Limited, New Delhi, 2007.
2. Gupta, P.K. *Elements of Biotechnology*. Rastogi Publications, Meerut, 2003.
3. Jogdand, S. N. *Gene Biotechnology*; (5<sup>th</sup> Edition) Himalaya Publishing House, 2000.
4. Reed. G. Prescott and Dunn. *Industrial Microbiology*. Macmillian Publication., 1982.

#### **REFERENCE BOOKS:**

1. Hugo W. B and Russell A.D. *Pharmaceutical Microbiology*. Sixth Edition, The Black well Science Ltd., UK, 1998.
2. Stanbury., P.F.A. Whitaker and Hall. *Principles of Fermentation Technology*, 2002.

#### **Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>  | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|---|-----------------------|------------------------|
| CO-1          | Analyse the Fermentation process and principles.                  | 1,3                   | Analyzing              |
| CO-2          | Infer the design and construction of fermentor.                   | 3,5                   | Understanding          |
| CO-3          | Determine the various parameter require for fermentation process. | 1,2                   | Evaluating             |
| CO-4          | Classify the different fermented food products.                   | 4,5                   | Analyzing              |
| CO-5          | Develop the knowledge in Fermentation economics.                  | 4,5                   | Creating               |

### Relationship Matrix

| Semester                    | Course Code                                       | Title of the Course        | Hours | Credit |       |                                       |       |       |       |       |
|-----------------------------|---|----------------------------|-------|--------|-------|---------------------------------------|-------|-------|-------|-------|
| I                           | 21PEMB2C  | FERMENTATION<br>TECHNOLOGY | 60    | 4      |       |                                       |       |       |       |       |
| Course<br>Outcomes<br>(COs) | Programme Learning<br>Outcomes (PLOs)             |                            |       |        |       | Programme Specific<br>Outcomes (PSOs) |       |       |       |       |
|                             | PLO 1   | PLO 2                      | PLO 3 | PLO 4  | PLO 5 | PSO 1                                 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1                        | ✓   |                            | ✓     | ✓      | ✓     | ✓                                     |       | ✓     | ✓     | ✓     |
| CO-2                        | ✓   | ✓                          | ✓     |        | ✓     |                                       | ✓     | ✓     |       | ✓     |
| CO-3                        | ✓   | ✓                          |       | ✓      |       | ✓                                     |       |       | ✓     |       |
| CO-4                        |   | ✓                          | ✓     |        | ✓     |                                       | ✓     | ✓     |       | ✓     |
| CO-5                        | ✓   | ✓                          | ✓     | ✓      | ✓     | ✓                                     | ✓     |       | ✓     | ✓     |
|                             | Number of matches (✓) = 36<br>Relationship = High |                            |       |        |       |                                       |       |       |       |       |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – II

| <b>Course Title</b> | <b>TECHNIQUES IN MICROBIAL PHYSIOLOGY AND VIROLOGY</b> |
|---------------------|--|
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PCMB2P1  |
| Course Type         | DSCP III   |
| Credits             | 2  |
| Marks               | 100  |

### **General Objective:**

The course helps to Hands on experience in Biochemical and to determine the bacterial growth curve and thermal death time and also the Biochemical identification of bacteria.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                                   |
|---------------|--|
| CO-1          | Identify coli phage from sewage.                           |
| CO-2          | Practice and observation of Virus infected Plant.          |
| CO-3          | Experiment of Virus-Chick Embryo Method.                   |
| CO-4          | Combine the Bacterial growth curve and thermal death time. |
| CO-5          | Choose the Biochemical tests for different Bacteria.       |

1. Bacterial Growth curve (Turbidity method).
2. Effect of pH, Temperature and Oxygen on bacterial growth.
3. Thermal Death Time
4. Biochemical tests for Identification of Bacteria-
  - a) IMViC
  - b) Triple sugar iron test
  - c) H<sub>2</sub>S test
  - a) Urease test
  - b) Catalase test
  - c) Nitrate reduction
  - d) Oxidase Test
5. Carbohydrate fermentation test- a) Glucose, b) Lactose
6. Production of Extra cellular enzyme by microorganisms:

- a) Starch hydrolysis
  - b) Casein hydrolysis
  - c) Gelatin hydrolysis
  - d) Lipid hydrolysis
7. Isolation of coli phage from sewage.
8. Study and observation of Virus infected Plant (Leaf).
9. Cultivation of Virus-Chick Embryo Method (Demonstration).

**REFERENCE BOOKS:**

1. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*, 10th Edition. Pearson education Limited, 2014.
2. Kannan. *Laboratory Manual in General Microbiology*, Palani Paramount Publications, Palani, 1996.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>                                       | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Restate the knowledge on phage titration.                    | 1,3                   | Understanding          |
| CO-2          | Practise the various stages of bacterial growth curve.       | 2,3                   | Applying               |
| CO-3          | Examine the biochemical identification of bacteria.          | 4,5                   | Analyzing              |
| CO-4          | Compare the production of enzymes using various hydrolysis.  | 1,4                   | Evaluating             |
| CO-5          | Compose the physiological requirements for bacterial growth. | 2,4                   | Creating               |

### Relationship Matrix

| Semester              | Course Code                                      | Title of the Course  | Hours | Credit |       |                                    |       |       |       |       |
|-----------------------|--|--|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| II                    | 21PCMB2P1  | <b>TECHNIQUES IN<br/>MICROBIAL PHYSIOLOGY<br/>AND VIROLOGY</b> | 60    | 2      |       |                                    |       |       |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)               |  |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|                       | PLO 1  | PLO 2  | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1                  | ✓  |  | ✓     | ✓      | ✓     |                                    | ✓     | ✓     |       | ✓     |
| CO-2                  | ✓  |  | ✓     | ✓      | ✓     | ✓                                  | ✓     |       |       | ✓     |
| CO-3                  |  | ✓  |       | ✓      | ✓     | ✓                                  | ✓     | ✓     | ✓     | ✓     |
| CO-4                  |  | ✓  | ✓     | ✓      | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-5                  | ✓  | ✓  |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
|                       | Number of matches (✓) =38<br>Relationship = High |  |       |        |       |                                    |       |       |       |       |

Prepared by  
Dr. K. Feroz Khan  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER – II

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>TECHNIQUES IN BIOCHEMISTRY, MOLECULAR BIOLOGY AND GENETIC ENGINEERING</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PCMB2P2  |
| Course Type         | DSCP IV  |
| Credits             | 2  |
| Marks               | 100  |

### General Objective:

The course performs the practical knowledge on estimation of various types of biomolecules and also chromatographic techniques.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>             |
|---------------|--------------------------------------|
| CO-1          | Identify Carbohydrates and Lipids.   |
| CO-2          | Examine amino acids and proteins.    |
| CO-3          | Test the proteins by SDS –PAGE.      |
| CO-4          | Design the Mutagenesis.              |
| CO-5          | Rate to Know the Genetic Techniques. |

1. Estimation of Proteins by Lowry's method.
2. Estimation of Sugar by Anthrone method.
3. Estimation of Ascorbic Acid.
4. Separation of amino acid by paper chromatography.
5. Separation of amino acid by thin layer chromatography.
6. Separation of Protein by SDS- PAGE.
7. Induced Mutagenesis – UV
8. PCR (DEMO).
9. Restriction Enzyme digestion and ligation of DNA
10. Conjugation.
11. Transformation.
12. Replica plate method- Auxotrophs.
13. Gradient plate technique.

### REFERENCE BOOKS:

1. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*, 10th Edition. Pearson education Limited, 2014.
2. Kannan. *Laboratory Manual in General Microbiology*, Palani Paramount Publications, Palani, 1996.



### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Report the protein by Lowry's method.   | 1,3            | Understanding   |
| CO-2   | Examine the sugar by using Anthrone method.   | 2,3            | Applying        |
| CO-3   | Relate the techniques in separation of amino acid by paper and thin chromatography. | 2,5            | Analyzing       |
| CO-4   | Compose the Separation of Protein by SDS- PAGE.                                     | 4,5            | Evaluating      |
| CO-5   | Convince about PCR.   | 3,4            | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course  |       |       |       |                                    | Hours | Credit |       |       |
|--|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| II   | 21PCMB2P2                          | <b>TECHNIQUES IN<br/>BIOCHEMISTRY,<br/>MOLECULAR BIOLOGY<br/>AND GENETIC<br/>ENGINEERING</b> |       |       |       |                                    | 60    | 2      |       |       |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|  | PLO 1                              | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1   | ✓                                  | ✓  | ✓     | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-2   | ✓                                  | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |
| CO-3   |                                    | ✓  | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4   |                                    | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5   | ✓                                  | ✓  | ✓     |       | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| Number of matches (✓) =39<br>Relationship = High |                                    |  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

**SEMESTER - II**

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>SWAYAM - NPTEL ONLINE CERTIFICATION COURSE</b> |
| Total Hrs           | 40  |
| Hrs/Week            | 2   |
| Sub.Code            | 21PSMB21  |
| Course Type         | SEC   |
| Credits             | 2   |
| Marks               | 100   |

### SEMESTER – III

| Course Title | IMMUNOLOGY |
|--------------|------------|
| Total Hrs    | 75         |
| Hrs/Week     | 5          |
| Sub.Code     | 21PCMB31   |
| Course Type  | DSC 7      |
| Credits      | 4          |
| Marks        | 100        |

#### General Objective:

The course helps to understand the fundamentals of Immunology, the importance of immunization and various diagnostic methods.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives   |
|--------|---|
| CO-1   | Summarize the significance of immunology.                         |
| CO-2   | Relate the different types antigens.                              |
| CO-3   | Classify the Immunoglobulins.                                     |
| CO-4   | Plan about Vaccines and Immunization.                             |
| CO-5   | Compare the knowledge on different pathways of complement system. |

#### Unit I: Immune System (15 hours)

**Historical background and scope of immunology** -Introduction to the immune system, Innate immunity- anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity - natural and artificial immunity. Cells involved in immune response: lymphoid lineage (producing B and T lymphocytes) and Myeloidlineage (phagocytes: macrophages, neutrophils and eosinophils, Auxillary cells, basophils, mast cells and platelets). Organs involved in immune system: primary and secondary lymphoid organs.

#### Unit II: Antigens and Immunoglobulins (15 hours)

Antigens: Types and properties of antigens- Haptens, Super antigens and clusters of differentiation molecules (CDs); Preparation of antigens, Processing and presentation of antigens. Immunoglobulins: Structure, Types, Functions of immunoglobulins, & genetic diversity of immunoglobulins, catalytic antibodies. B-cell biology and T-cell biology (major his to compatibility complex (MHC) molecules) HLA and H-2 systems.



### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Discuss the physical, chemical and physiological components of the immune system. | 1,3            | Understanding   |
| CO-2   | Demonstrate the Major Histocompatibility Complex (MHC).                           | 2,3            | Applying        |
| CO-3   | Classify the essential elements of the immunization and immune disorder.          | 4,5            | Analyzing       |
| CO-4   | Combine different types of complement pathway.                                    | 4              | Evaluating      |
| CO-5   | Revise the important serological tests.   | 3,5            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course |       |       |       |                                    | Hours | Credit |       |       |  |  |
|---|------------------------------------|---------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| III   | 21PCMB31                           | IMMUNOLOGY          |       |       |       |                                    | 75    | 4      |       |       |  |  |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                     |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|   | PLO 1                              | PLO 2               | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1  | ✓                                  | ✓                   |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| CO-2  | ✓                                  | ✓                   | ✓     |       | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-3  | ✓                                  |                     |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-4  |                                    | ✓                   | ✓     | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-5  | ✓                                  | ✓                   |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |  |  |
| Number of matches (✓) = 38<br>Relationship = High |                                    |                     |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Departme

### SEMESTER – III

|                     |                             |
|---------------------|-----------------------------|
| <b>Course Title</b> | <b>MEDICAL MICROBIOLOGY</b> |
| Total Hrs           | 75                          |
| Hrs/Week            | 5                           |
| Sub.Code            | 21PCMB32                    |
| Course Type         | DSC 8                       |
| Credits             | 4                           |
| Marks               | 100                         |

#### **General Objective:**

The course helps to comprehend the collection of clinical samples and laboratory diagnosis of various viral diseases and antimicrobial agents.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Explain the Historical developments in medical microbiology.      |
| CO-2          | Apply their knowledge on major human diseases.                    |
| CO-3          | Analyse clinical sample collections and diagnosis.                |
| CO-4          | Manage about bacterial, fungal and viral human pathogens.         |
| CO-5          | Assess the diseases caused by intestinal and urogenital protozoa. |

#### **Unit I: Basics in Medical Microbiology (15 hours)**

Historical developments in medical microbiology, Normal flora of human body, Role of the resident flora, Collection of clinical samples and laboratory diagnosis of important bacterial infections, Pathogenic microorganisms. Brief account of major air, water and soilborne diseases of microbial origin and their preventive and control measures.

#### **Unit II: Bacteriology (15 hours)**

Introduction- Important human diseases caused by *Staphylococcus*, *Streptococcus*, *Pneumococcus*, *Neisseria*, *Bacillus*, *Corynebacterium*, *Clostridium*, *Pseudomonas*, *Yersinia*, *Haemophilus*, *Mycobacterium*, Antibacterial agents and susceptibility test, Bacterial vaccines.

#### **Unit III: Virology (15 hours)**

Introduction - Collection of clinical samples and laboratory diagnosis of important viral diseases - Mumps, Measles, Influenza, Adenovirus,

Enterovirus, Rhinovirus, Poxvirus, Hepatitis virus; Herpesvirus, AIDS, Antiviral drugs, Viral vaccines, Interferons, Tumoviruses, antiviral agents and susceptibility test.

#### **Unit IV: Mycology (15 hours)**

Introduction - Classification of medically relevant fungi, Collection of clinical samples and laboratory diagnosis of important human fungal diseases : Candidiasis, Dermatophytosis, Aspergillosis, Otomycosis, Cutaneous and subcutaneous mycoses, Systemic mycoses, Opportunistic mycoses, Antifungal agents (specific to disease to included in course) and their susceptibility test.

#### **Unit V: Parasitology (15 hours)**

Introduction - Important diseases caused by intestinal and urogenital protozoa: *Entamoeba*, *Giardia*, *Trichomonas*. Blood and tissue protozoa; *Plasmodium*, *Trypanosoma*, *Leishmania*, *Cestodes*, *Taenia*, *Trematodes*, *Schistosoma*, *Paragonimus*, Nematodes: *Ascaris*, *Ancylostoma*, Necator- laboratory diagnosis, treatment and prevention, antiparasitic agent and susceptibility test.

#### **TEXT BOOKS:**

1. Greenwood, D. *Medical Microbiology*, 4th Ed., I.K. International, 2007.
2. Murray P.R., Tenover F.C., and Tenover F.C., and Tenover F.C. *Clinical Microbiology*, ASM Press, 2007.
3. Talaro K. P. and Talaro, A. *Foundations in Microbiology* (6th Ed.), McGraw-Hill College, Dimensi, 2006.

#### **REFERENCE BOOKS:**

1. Atlas, R. M. *Principles of Microbiology*, II Ed., McGraw Hill, 1997.
2. Harvey, R.A., Champe, P.C. and Fisher, B.D. *Lippincott's Illustrated Reviews : Microbiology*. 2009.
3. Lippincott Williams and Wilkins, New Delhi/New York. 2006.
4. Nester, E. W., Anderson, D. G. and Nester, M. T. *Microbiology: A Human Perspective*, McGraw Hill, 2006.
5. Willey, J., Sherwood, L. and Woolverton, C. *Prescott/Harley/Klein's Microbiology*, McGraw Hill, 2007.

### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Summarize the role of normal flora in human body.                               | 1,3            | Understanding   |
| CO-2   | Interpret various clinically important bacteria and their mode of infection.    | 3,5            | Applying        |
| CO-3   | Distinguish the comprehensive theoretical knowledge of pathogenic viruses.      | 2,4            | Analyzing       |
| CO-4   | Evaluate the epidemiology and lab diagnosis                                     | 1,5            | Evaluating      |
| CO-5   | Organize the different causative agents of the infectious diseases to find new. | 2,5            | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course  |       |       |       |                                    | Hours | Credit |       |       |  |  |
|--|------------------------------------|----------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| III  | 21PCMB32                           | MEDICAL MICROBIOLOGY |       |       |       |                                    | 75    | 4      |       |       |  |  |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |                      |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|  | PLO 1                              | PLO 2                | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1   |                                    | ✓                    | ✓     | ✓     | ✓     | ✓                                  | ✓     | ✓      | ✓     | ✓     |  |  |
| CO-2   | ✓                                  | ✓                    |       |       | ✓     |                                    | ✓     |        | ✓     | ✓     |  |  |
| CO-3   | ✓                                  | ✓                    | ✓     |       | ✓     | ✓                                  |       | ✓      |       | ✓     |  |  |
| CO-4   |                                    | ✓                    |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-5   | ✓                                  |                      |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| Number of matches (✓) =36<br>Relationship = High |                                    |                      |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department



### SEMESTER – III

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>RESEARCH METHODOLOGY AND BIostatISTICS</b> |
| Total Hrs           | 75  |
| Hrs/Week            | 5   |
| Sub.Code            | 21PCMB33                                      |
| Course Type         | DSC   |
| Credits             | 4   |
| Marks               | 100   |

#### General Objective:

The course creates knowledge in writing research articles and paves a way to interpret the statistical results.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                                   |
|---------------|--|
| CO-1          | Identify the various research areas.                       |
| CO-2          | Practise the Presentation in Seminars and Conferences.     |
| CO-3          | Experiment the Research methods in biological sciences.    |
| CO-4          | Collect the Basics in Biostatistics.                       |
| CO-5          | Evaluate the Different forms Measures of central tendency. |

#### UNIT I: Basics of Research (15 hours)

Introduction – importance - identification of research areas. Review of Literature- Research design and experimentation-Preparation of research report. Guidelines for preparing an article -ISSN, ISBN impact factor, citation index, h-index, I-index, Google scholar, Scopus. Computers in biological research-methods of data presentation, graphical representation by histogram, polygon, ogive curves and pie diagram.

#### UNIT II: Article Publication (15 hours)

Presentation in Seminars and Conferences - Writing scientific paper- Organization of scientific paper - Importance of title -abstract –key words, Introduction, Materials and methods, Results, Discussion. Acknowledgements and References - Publication in research journals - Standards of Research journals- Peer - Review – Impact factor - Citation index - Preparation of manuscript – Proof correction - Proof correction marks- Method of correcting proof- Writing chapters in books -Preparation of Research proposal and funding agencies – Research fellowships.

### **UNIT III: Research and Project writing methods (15 hours)**

Research-Definition, Objectives, Types and Importance - Research methods in biological sciences - Research process- Literature survey - Sources -Scientific databases- Research report writing - Parts of Thesis and Dissertation -Title, certificate, declaration, acknowledgements, contents, List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods-Results - Presentation of data - Tables, figures, map, graphs, photographs - Discussion - Summary, Bibliography/ References and Appendix.

### **UNIT IV: Basics in Biostatistics (15 hours)**

Basic definitions and applications Biostatistics - Statistical methods - Basic principles. Variables - measurements, Functions, Limitations and Uses of Statistics. Collection of data primary and Secondary - Types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods graphical representation by histogram, polygon, ogive curves and pie diagram.

### **UNIT V: Measures of central tendency (15 hours)**

Mean, Median, Mode, Geometric mean - Merits and Demerits. Measures of dispersion - Range, Standard deviation, standard error, range, Mean deviation, Quartile deviation - Merits and Demerits; Co-efficient of variations. Correlation - Types and methods of Correlation, Regression, Simple Regression equation, Statistical inference - Hypothesis - Simple hypothesis - Student 't' test - Chi square test ANOVA, one and two way classification.

### **REFERENCE BOOKS:**

1. Vijayalakshmi, G. and C. Sivapragasam. *Research Methods (Tips and Techniques)*. MJP Publishers, Chennai, 2008.
2. Gurumani, N. *Research Methodology for Biological Sciences*. MJP Publishers, Chennai, 2006.
3. Ramamurthi and Geetha Bali. *Bioethics and Biosafety*. APH Publishing, New Delhi, 2007.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Report the general laboratory procedures and maintenance of research equipments.                               | 1,2            | Understanding   |
| CO-2   | Illustrate the techniques of isolation, fractionation and separation of cellular constituents.                 | 4,3            | Applying        |
| CO-3   | Relate the various spectroscopic techniques.   | 4,2            | Analyzing       |
| CO-4   | Evaluate projects using gained knowledge through research and project writing methods.                         | 5,1            | Evaluating      |
| CO-5   | Prepare and present research papers in seminar, conferences and writing scientific paper in research journals. | 5              | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course                                   |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|---|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| III   | 21PCMB33                           | <b>RESEARCH<br/>METHODOLOGY AND<br/>BIOSTATISTICS</b> |       |       |       |                                    | 75    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |   |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2   | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  | ✓   |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| CO-2  | ✓                                  | ✓   |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-3  | ✓                                  |   |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4  |                                    | ✓   |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |
| CO-5  | ✓                                  | ✓   |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| Number of matches (✓) = 36<br>Relationship = High |                                    |   |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

### SEMESTER – III

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>QUALITY ASSURANCE IN MICROBIOLOGY</b> |
| Total Hrs           | 60                                       |
| Hrs/Week            | 4  |
| Sub.Code            | 21PEMB31A                                |
| Course Type         | DSE                                      |
| Credits             | 4  |
| Marks               | 100                                      |

#### **General Objective:**

The course helps the learners to cognize of laboratory hazards, quality assessment and disposal of waste.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Discuss the good laboratory practices and quality standards.                      |
| CO-2          | Apply the quality control methodology   |
| CO-3          | Test the quality of equipment, chemicals, glass wares and laboratory environment. |
| CO-4          | Construct the Quality assurance.  |
| CO-5          | Rate the Ethics of waste Products.  |

#### **UNIT I: Good Laboratory Practices and Quality standards (12 hours)**

Introduction – Management of laboratory hazards and knowledge in First aid procedures. Bioethics –Introduction, Social and ethical issues in Microbial biotechnology. Definition of Biosafety, Biosafety for human health and environment. Quality benchmarking, details of international standards (ISO, GMP, GLP, TGM, VAN, FDA, FSSAI, AGMARK, HACCP and ISI) and fact sheet evaluation.

#### **UNIT II: Quality Control (12 hours)**

Introduction and overview – Definition, Designing microbiology laboratory - Quality Control and its Applications. Regulatory Affairs: Regulation, national and international guidelines of Biosafety, rDNA guidelines, Regulatory requirements for drugs and Biologics GLP and GMP.

#### **UNIT III: Quality assessment (12 hours)**

Quality assessment of Equipment, Chemicals, Glasswares and Laboratory environment –Variance – Quality control calculations – Quality management – Maintenance of records and reports. International and

National conventions on Microbiotechnology and related areas, WTO guidelines.

#### **UNIT IV: Quality assurance (12 hours)**

Quality assurance in Sterilization and Disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains. Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the three mile island and case studies.

#### **UNIT V: Ethics of waste Products (12 hours)**

Quality assessment of disposal, decontaminated matters and other biological effluents. Quality management in transportations of cultures. National control of Biological references and standards. Microbial quality control of pharmaceutical products. Global Issues: Environmental ethics - computer ethics and bioterrorisms. Sample code of Ethics.

#### **TEXT BOOKS:**

1. Harvey, R.A., Champe, P.C. and Fisher, B.D. *Lippincott's Illustrated Reviews: Microbiology*, 2009.
2. Muherjee, L.K. *Medical Lab Technology* – 3 Volumes; 2001.
3. Rajesh Bhatia and Rattan lalchhpujani. *Quality assurance in Microbiology*, I ed; 1995.

#### **REFERENCE BOOKS:**

1. Edmund G Seebauer and Robert L Barry. *Fundamentals of Ethics for Scientists and Engineers*, Oxford University Press, Oxford, 2001.
2. Singh, K. *Intellectual Property Rights on Biotechnology*, BCIL, New Delhi, 2009.

### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Acquire management skills in laboratory hazards.  | 1,5            | Understanding   |
| CO-2   | Sketch a microbiological laboratory.  | 1,4            | Applying        |
| CO-3   | Calculate the quality assessment of the equipments, chemicals, glass wares and laboratory environment.      | 1,3            | Analyzing       |
| CO-4   | Formulate the preservation of stock cultures, media and diagnostic kits.                                    | 3,4            | Evaluating      |
| CO-5   | Review and judge the quality assessment of disposal, decontaminated matters and other biological effluents. | 4,5            | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course               | Hours | Credit |       |                                    |       |       |       |       |
|--|------------------------------------|-----------------------------------|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| III  | 21PEMB31A                          | QUALITY ASSURANCE IN MICROBIOLOGY | 60    | 4      |       |                                    |       |       |       |       |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |                                   |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|  | PLO 1                              | PLO 2                             | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1   | ✓                                  | ✓                                 |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| CO-2   | ✓                                  | ✓                                 |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-3   | ✓                                  |                                   | ✓     |        | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-4   | ✓                                  | ✓                                 |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-5   |                                    | ✓                                 | ✓     |        | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| Number of matches (✓) =38<br>Relationship = High |                                    |                                   |       |        |       |                                    |       |       |       |       |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

### SEMESTER – III

|                     |                              |
|---------------------|------------------------------|
| <b>Course Title</b> | <b>FORENSIC MICROBIOLOGY</b> |
| Total Hrs           | 60                           |
| Hrs/Week            | 4                            |
| Sub.Code            | 21PEMB31B                    |
| Course Type         | DSE                          |
| Credits             | 4                            |
| Marks               | 100                          |

#### **General Objective:**

To introduce the basic principles and practical applications of Forensic Science.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the organizational Structure of Forensic Science laboratory                          |
| CO-2          | Interpret the different crime scene and clues.  |
| CO-3          | Analyze the strategies forensic psychology  |
| CO-4          | Evaluate the fingerprints pattern and formation of ridges                                       |
| CO-5          | Create an awareness in collection, evaluation and tests for identification of forensic samples. |

#### **UNIT I: Forensic Science (12 hours)**

Definition, Introduction , Basic Principles & Significance, History & Development of Forensic Science in India and World, Organizational Structure of Forensic Science laboratory ,Different divisions and units of Forensic Science Laboratory , Organizational Structure of Forensic Science teaching Institution.

#### **UNIT II: Crime (12 hours)**

Crime: - Definition & causation, crime scene, types of crime, processing of crime scene, protection and recording of crime scene, search of physical clues, collection and preservation, packing and forwarding of physical clues to Forensic Science Laboratory. (including photography and sketching)

### **UNIT III: Forensic Psychology (12 hours)**

Basics of Forensic Psychology:- Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology. Assessment of mental competency. Mental disorders and forensic psychology.

### **UNIT IV: Basics of Fingerprinting (12 hours)**

Basics of Fingerprinting:- Introduction and history, with special reference to India. Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns.

### **UNIT V: Importance of Forensic Science (12 hours)**

Forensic Importance of Body fluids :-Common body fluids. Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies. Forensic characterization of bloodstains. Typing of dried stains. Blood enzymes and proteins. Semen. Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on the basis of semen examination. Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.

#### **TEXT BOOKS:**

1. W.G. Eckert and S.H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989).
2. G.T. Duncan and M.I. Tracey in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).
3. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
4. T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).

#### **REFERENCE BOOK**

1. Bruce Budowle, Steven Schutzer, Roger Breeze, Microbial Forensics 1st Edition - May 16, (2005)
2. David O. Carter , Jeffery K. Tomberlin , M. Eric Benbow , Jessica L. Metcalf , Forensic Microbiology,Wiley publications, April 2017



3. Tom Bevel , Tom Gardner , David R. Fisher, Techniques of Crime Scene Investigation (Forensic and Police Science),CRC Press, June 2012

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Analyse the development of forensic units                | 1,3            | Analyzing       |
| CO-2   | Infer the processing and preservation of clues           | 3,4            | Understanding   |
| CO-3   | Determine the law and ethical issues in forensic science | 1,4            | Evaluating      |
| CO-4   | Classify the different finger print pattern              | 4,5            | Analyzing       |
| CO-5   | Develop the knowledge in importance of body fluids       | 4,5            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course    | Hours | Credit |       |                                    |       |       |       |       |
|---|------------------------------------|------------------------|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| I   | 21PEM3B                            | FORESENIC MICROBIOLOGY | 60    | 4      |       |                                    |       |       |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                        |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|   | PLO 1                              | PLO 2                  | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |                        |       | ✓      |       | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-2  | ✓                                  | ✓                      | ✓     |        | ✓     |                                    | ✓     | ✓     |       | ✓     |
| CO-3  | ✓                                  | ✓                      |       | ✓      |       | ✓                                  | ✓     |       | ✓     |       |
| CO-4  |                                    | ✓                      | ✓     |        | ✓     | ✓                                  | ✓     | ✓     | ✓     | ✓     |
| CO-5  | ✓                                  | ✓                      | ✓     | ✓      | ✓     | ✓                                  | ✓     | ✓     | ✓     | ✓     |
| Number of matches (✓) = 38<br>Relationship = High |                                    |                        |       |        |       |                                    |       |       |       |       |

Prepared by  
Dr. M. Suriya Prabha  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Departme

### SEMESTER – III

|                     |                                 |
|---------------------|---------------------------------|
| <b>Course Title</b> | <b>VERTERINARY MICROBIOLOGY</b> |
| Total Hrs           | 60                              |
| Hrs/Week            | 4                               |
| Sub.Code            | 21PEMB31C                       |
| Course Type         | DSE                             |
| Credits             | 4                               |
| Marks               | 100                             |

#### General Objective

Acquired skills on the laboratory identification of disease causing microbes, antibiotic sensitivity testing of microbial etiology for animals and the vaccines available for animal immunization..

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the history and development of microbiology                        |
| CO-2          | Interpret the physiochemical and biological characteristics of microorganisms |
| CO-3          | Analyze the microbial technique in vertinary microbiology                     |
| CO-4          | Evaluate the sources of infection in animals.                                 |
| CO-5          | Create awareness about veterinary diseases and prevention.                    |

#### Unit I: Microbial world (12 hours)

History of microbiology and introduction to the microbial world. Microorganisms and fermentation, Germ theory of diseases, Development of various Microbiological techniques and golden era of microbiology. Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff, Edward Jenner.

#### Unit II: Characteristics of microorganisms (12 hours)

Physiochemical and biological characteristics of microorganisms (including viruses). Introduction to oncogenic viruses. Types of oncogenic DNA and RNA viruses: Bacterial structure, Nutritional requirements of

bacteria, Types of media, Physical conditions required for bacterial growth, Bacterial growth curve, methods of measurement of bacterial growth

**Unit III: Microbial techniques (12 hours)**

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria,. Buffers in culture medium. Cultivation of fungi, actinomycetes, yeasts, Cultivation of anaerobes. Optical and Electron microscope (Structure and function),

**Unit IV: Sources of infection (12 hours)**

Sources and routes of infection, Transmission of pathogens, portals of entry of pathogen, Microorganisms and animal host interactions, Toxins (endo and exo)

**Unit V: Animal diseases and its etiology (12 hours)**

Study of following animal diseases with respect to etiology, symptoms, mode of transmission, prophylaxis and control: Q fever FMD, swine flu, bird flu, Rabies, bovine tuberculosis, Common cattle disease Bovine Respiratory Disease Complex (BRDC), Clostridial Disease, or "Blackleg" ,BRSV (Bovine Respiratory Syncytial Virus) BVD (Bovine Viral Diarrhea) (Infectious Bovine Rhinotracheitis), (Parainfluenza Type III), Pasteurella haemolytica and Pasteurella multocida.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>   | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Analyse the development of various Microbiological techniques  | 1,2                   | Analyzing              |
| CO-2          | Infer the physiochemical and biological characteristics of microorganisms                              | 3,4                   | Understanding          |
| CO-3          | Evaluate the various Microbial techniques in Veterinary Microbiology                                   | 1,4                   | Evaluating             |
| CO-4          | Classify the Microorganisms and animal host interactions   | 4,5                   | Analyzing              |
| CO-5          | Develop the knowledge in animal diseases with respect to etiology especially the domesticated animals. | 3,4                   | Creating               |

### Relationship Matrix

| Semester  | Course Code                           | Title of the Course         |       |       |       |                                       | Hours | Credit |       |       |
|---|---------------------------------------|-----------------------------|-------|-------|-------|---------------------------------------|-------|--------|-------|-------|
| III   | 21PEM31C                              | VERTERINARY<br>MICROBIOLOGY |       |       |       |                                       | 60    | 4      |       |       |
| Course<br>Outcomes<br>(COs)                       | Programme Learning<br>Outcomes (PLOs) |                             |       |       |       | Programme Specific<br>Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                                 | PLO 2                       | PLO 3 | PLO 4 | PLO 5 | PSO 1                                 | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  |                                       | ✓                           |       | ✓     |       | ✓                                     |       | ✓      | ✓     | ✓     |
| CO-2  | ✓                                     | ✓                           | ✓     | ✓     | ✓     |                                       | ✓     | ✓      |       | ✓     |
| CO-3  | ✓                                     | ✓                           |       | ✓     | ✓     | ✓                                     |       |        | ✓     | ✓     |
| CO-4  | ✓                                     | ✓                           | ✓     |       | ✓     | ✓                                     | ✓     | ✓      | ✓     | ✓     |
| CO-5  | ✓                                     | ✓                           | ✓     | ✓     | ✓     | ✓                                     |       | ✓      | ✓     | ✓     |
| Number of matches (✓) = 39<br>Relationship = High |                                       |                             |       |       |       |                                       |       |        |       |       |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

### SEMESTER- III

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>TECHNIQUES IN IMMUNOLOGY AND RESEARCH METHODOLOGY</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PCMB3P1  |
| Course Type         | DSCP V   |
| Credits             | 2  |
| Marks               | 50   |

#### General Objective:

The Course helps to create practical knowledge in blood grouping, serological tests and assists to gather information in statistical interpretation.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Identify the Blood Grouping and various serological tests.          |
| CO-2          | Practice the Antigen- Antibody reaction.                            |
| CO-3          | Experiment the data collection and writing research papers.         |
| CO-4          | Construct skill in Sample and Data collection for the Project work. |
| CO-5          | Evaluate the Variance by using ANOVA.                               |

1. Blood Grouping.
2. WIDAL test- Qualitative and Quantitative.
3. ASO.
4. CRP.
5. VDRL.
6. Antigen- Antibody reaction – Ouchterlony technique.
7. Antigen- Antibody reaction – Single radial Immunodiffusion.
8. ELISA- (DEMO).
9. **Sample and Data collection of the Project work.**
10. Calculation of Mean, Mode, Median.
11. Calculation of Standard Deviation and Standard Error.
12. Analysis of Variance (ANOVA).

#### REFERENCE BOOKS:

1. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited. 2014.
2. Kannan. *Laboratory Manual in General Microbiology*. Palani Paramount Publications, Palani, 1996.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Summarize various test of immunology.  | 1,3            | Understanding   |
| CO-2   | Interpret the applications of assays in the diagnosis of microbial diseases. | 4,2            | Applying        |
| CO-3   | Analyse knowledge in various Antigen- Antibody reaction                      | 2,1            | Analyzing       |
| CO-4   | Compare the various steps in statistical tools (ANOVA) in biostatistics.     | 2, 1           | Evaluating      |
| CO-5   | Design the practical skill in Calculation of Mean, Mode, and Median.         | 5              | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course                                      |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| III   | 21PCMB3P1                          | <b>TECHNIQUES IN IMMUNOLOGY AND RESEARCH METHODOLOGY</b> |       |       |       |                                    | 60    | 2      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-2  | ✓                                  | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-3  | ✓                                  | ✓  | ✓     |       | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4  | ✓                                  | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5  |                                    | ✓  | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| Number of matches (✓) = 38<br>Relationship = High |                                    |  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

### SEMESTER-III

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>TECHNIQUES IN MEDICAL AND QUALITY ASSURANCE<br/>IN MICROBIOLOGY</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PCMB3P2  |
| Course Type         | DSCP VI  |
| Credits             | 2  |
| Marks               | 50   |

#### **General Objective:**

The course hands on diagnosis of various pathogens from clinical samples, and facilitates to gather information of laboratory hazards.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                              |
|---------------|---|
| CO-1          | Identify the various clinical samples                 |
| CO-2          | Practise self-confidence                              |
| CO-3          | Experiment the Fungal Pathogen from dandruff.         |
| CO-4          | Plan a knowledge in Design of microbiology laboratory |
| CO-5          | Rate the knowledge in First aid procedures            |

1. Isolation of normal micro flora of skin and throat.
2. Isolation and identification of UTI causing Pathogen from urine.
3. Isolation and identification of Pathogen from wound and pus.
4. Isolation and identification of Pathogen from sputum.
5. Isolation and identification of bacterial and Fungal Pathogen from dandruff.
6. Antibiotic sensitivity test- Well diffusion method and Disc Diffusion Method.
7. Management of laboratory hazards and knowledge in First aid procedures.
8. Designing of microbiology laboratory.

#### **REFERENCE BOOKS:**

1. Cappuccino, J.G. and Sherman N. *Microbiology: A Laboratory Manual*. 10th Edition. Pearson education Limited, 2014.
2. Kannan. *Laboratory Manual in General Microbiology*. Palani Paramount Publications, Palani, 1996.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Explicates the methods on medical microbiology.                                      | 2,1            | Understanding   |
| CO-2   | Substantiates the isolation and identification of clinically important pathogens.    | 4,2            | Applying        |
| CO-3   | Analyse the antibacterial sensitivity test by using disc and well diffusion methods. | 5,1            | Analyzing       |
| CO-4   | Collect the fungal pathogen from dandruff.   | 1,5            | Evaluating      |
| CO-5   | Value the minimum inhibitory concentration of antibiotics.                           | 2,3            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course  |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| III   | 21PCMB3P2                          | <b>TECHNIQUES IN<br/>MEDICAL AND QUALITY<br/>ASSURANCE IN<br/>MICROBIOLOGY</b> |       |       |       |                                    | 60    | 2      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  | ✓  | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| CO-2  | ✓                                  | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-3  | ✓                                  | ✓  | ✓     |       | ✓     | ✓                                  | ✓     | ✓      | ✓     | ✓     |
| CO-4  | ✓                                  | ✓  |       | ✓     | ✓     | ✓                                  | ✓     |        |       |       |
| CO-5  |                                    | ✓  | ✓     | ✓     | ✓     | ✓                                  | ✓     | ✓      | ✓     |       |
| Number of matches (✓) = 40<br>Relationship = High |                                    |  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department



### SEMESTER – III

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>ENTREPRENEURSHIP IN MICROBIOLOGY</b> |
| Total Hrs           | 40                                      |
| Hrs/Week            | 2                                       |
| Sub.Code            | 21PIMB31                                |
| Course Type         | IDC-I1                                  |
| Credits             | 2                                       |
| Marks               | 100                                     |

#### **General Objective:**

The course helps to gain the important concepts of entrepreneurship such as Planning, decision making, leadership, organizations and authority establishing a bio-based start-up and company.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Explain Entrepreneur and Entrepreneurship.                      |
| CO-2          | Relate the Production of microbiological products.              |
| CO-3          | Analyse the Production of Biofertilizer.                        |
| CO-4          | Assemble the various Marine resources                           |
| CO-5          | Choose the Marine resources cultivation and harvesting methods. |

#### **UNIT I: Entrepreneur (8 hours)**

Definition, Characteristics, Function, Types, Entrepreneurship: Definitions - concept, Factors affecting Entrepreneurial growth, Entrepreneurial motivation, Entrepreneurial competencies- Role of Entrepreneurship in Economic Development.

#### **UNITII: Production of microbiological products (8 hours)**

Introduction - Fermented dairy products, Food-SCP (Algae, Spirulina, Yeast, Mushroom, Bacterial probiotics). Commercial SCP Products in the market.

### **UNIT III: Biofertilizer (8 hours)**

Introduction- (Cyanobacteria, *Rhizobium*, *Azospirillum*, *Azotobacter*, *Frankia*, VAM). Vermicompost, Bioinsecticide (*Bacillus thuriengiensis*). Panchakavya, Fish Amino acids.

### **UNIT IV: Marine resources (8 hours)**

Sea weed, Sea grass, Coral reefs- Types, cultivation and harvesting methods and products. **Spirulina**

### **UNIT V: Finance and Support to Bio entrepreneurs (8 hours)**

Introduction - Government initiatives and Schemes. DST, CSIR, ICMR, DBT-BIRAC, BIG scheme, SIPCOT. Nationalized banks and other financial institutions. **Marketing Management**.

### **TEXT BOOKS:**

1. Gordon E and Natarajan K. *Entrepreneurship Development*. 5<sup>th</sup> Edition. Himalaya Publishing House, New Delhi. 2005.
2. Khanka SS., *Entrepreneurial Development*. S Chand Publishing, New Delhi. 2006.
3. Naidu NVR and Krishnarao T., *Management and Entrepreneurship*. I.K. International Pvt. Ltd, New Delhi. 2008.
4. Venkataraman G.S., *Algal Biofertilizers and Rice Cultivation*. Today and Tomorrow's Printers and Publishers, New Delhi. 1972.

### **REFERENCE BOOKS:**

1. Bhatnagar, B. and A. Budhiraja. *Entrepreneurship Development and Small Business Management*. Vayu Education of India, New Delhi, 2011.
2. Gupta, C.B. and N.P. Srinivasan. *Entrepreneurial Development in India*. Sultan Chand & Sons, New Delhi, 2014.
3. Hisrich, R.D, M.P. Peters and D.A. Shepherd. *Entrepreneurship*. 6<sup>th</sup> Edition, Mc Graw Hill; Irwin, 2005.
4. Tilak, KVBR. *Bacterial Biofertilizers*. IARI Publications, New Delhi, 1990.

### Course Outcomes

| CO No. | Course Outcomes   | PSOs Addressed | Cognitive Level |
|--------|---|----------------|-----------------|
| CO-1   | Cognize and explain the skills for entrepreneurs and finance management.          | 1,5            | Understanding   |
| CO-2   | Demonstrate the production of fermented dairy products.                           | 3,4            | Applying        |
| CO-3   | Compare different types of biofertilizers and bioinsecticides.                    | 1,2            | Analyzing       |
| CO-4   | Value the importance of cultivation of marine resources.                          | 4,5            | Evaluating      |
| CO-5   | Prepare the products from marine resources like sea weed, sea grass, coral reefs. | 4,3            | Creating        |

### Relationship Matrix

| Semester   | Course Code                        | Title of the Course              |       |       |       |                                    | Hours | Credit |       |       |  |  |
|--|------------------------------------|----------------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| III  | 21PIMB31                           | ENTREPRENEURSHIP IN MICROBIOLOGY |       |       |       |                                    | 40    | 2      |       |       |  |  |
| Course Outcomes (COs)                            | Programme Learning Outcomes (PLOs) |                                  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|  | PLO 1                              | PLO 2                            | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1   |                                    | ✓                                | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |  |  |
| CO-2   | ✓                                  |                                  |       | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-3   | ✓                                  | ✓                                | ✓     |       | ✓     | ✓                                  |       | ✓      |       | ✓     |  |  |
| CO-4   | ✓                                  | ✓                                | ✓     | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |  |  |
| CO-5   |                                    | ✓                                | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| Number of matches (✓) =38<br>Relationship = High |                                    |                                  |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – IV

|                     |                                    |
|---------------------|------------------------------------|
| <b>Course Title</b> | <b>FOOD AND DAIRY MICROBIOLOGY</b> |
| Total Hrs           | 75                                 |
| Hrs/Week            | 5                                  |
| Sub.Code            | 21PCMB41                           |
| Course Type         | DSC 10                             |
| Credits             | 4                                  |
| Marks               | 100                                |

### General Objective:

The course discuss how to gain knowledge using various methods of microbial analysis of food and dairy products and to understand the Government regulatory practices and policies.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Discuss the factors affecting the growth and survival of microorganisms in foods. |
| CO-2          | Demonstrate the food-borne diseases and food poisoning by microbial agents.       |
| CO-3          | Differentiate the Fermented Food products.  |
| CO-4          | Collect the knowledge in dairy Products and Probiotics.                           |
| CO-5          | Compare the Regulatory Policies for Dairy products.                               |

### UNIT I: Basics in Food Microbiology (15 hours)

Factors affecting the growth and survival of microorganisms in foods- Intrinsic factors- Nutrient content, pH,  $E_h$ , Antimicrobials and  $a_w$ , Extrinsic factors- Relative humidity, Temperature and Gaseous atmosphere. Methods for studying microbes and their products in food stuffs, Spoilage of fruits and Vegetables, Fresh and Processed Meats and Poultry and Miscellaneous foods such as eggs, bakery products, dairy products, beers and wines, fermented solid-substrate foods and canned foods.

### UNIT II: Food Borne diseases (15 hours)

Food-borne diseases and food poisoning by microbial agents- *Aeromonas*; *Brucella*; *Clostridium perfringens*; *Salmonella*; *Shigella*; *Staphylococcus aureus*; Protozoa (*Giardia*, *Entamoeba*), Toxigenic algae (dianoflagellates), Toxigenic fungi (*Aspergillus*) and Foodborne viruses (polio, hepatitis A and E and gastroenteritis viruses).

### **UNIT III: Fermented Food products (15 hours)**

Dairy products: - Production of starter cultures; Cheese - principles of cheese making. Cheddar Cheese, Swiss Cheese, Surface ripened Cheeses; Mold ripened Cheeses. General principles of manufacture of Yogurt, acidophilus milk, Kefir, Koumiss. Fermented foods: Soy sauce, Miso, Sufu, Natto, Idli, fermented fish products. Fermented vegetables: Sauerkraut, pickles, Olives. Fermented sausages.

### **Unit IV: Dairy Products and Probiotics (15 hours)**

Fermented dairy products: Cheese - yogurt/yoghurt - Kefir. Antimicrobial systems in milk. Prevention and control: Role of personnel and environmental hygiene at the level of production and processing. - Microbiological quality of fat rich products: Cream and butter. Frozen dairy products: Ice-cream. Prebiotic and Probiotic. Lactic acid Bacteria (LAB) as probiotics in development of health foods. Antibacterial activity and therapeutic property of probiotic cultures. LAB as nutraceutical ingredients.

### **UNIT V: Regulatory Policies for Dairy products (15 hours)**

Importance of Total Quality Management (TQM) in dairy industry - Current role of modified packaging for extending the shelf stability of indigenous dairy products, Antimicrobial packaging, controlled and modified atmosphere (CAP / MAP) based technologies. The hazard analysis and critical control point (HACCP), concept in controlling microbiological quality of foods. Government regulatory practices and policies: WHO - FDA - EPA - FSSAI. Food safety: Safety of dairy products.

### **TEXT BOOKS:**

1. Adams, M.R. and M.O. Moss. *Food Microbiology*, 2ed (Royal Society of Chemistry); 2000.
2. Doyle, M.P. and L.R. Beuchat. *Food Microbiology: Fundamentals and Frontiers*, 3ed. 1995.
3. Knorr, D. *Food Biotechnology*. Marcel Dekker, New York, 1982.

### **REFERENCE BOOKS:**

1. Brennan, J.G., Bulters, J.R., and Lilly, A.E.V., *Food Engineering Operations*, 2nd Edition, Applied Science Publishers, 1979.
2. Heldman, D.R., *Food Process Engineering*, 2nd Edition, AVI., 1977.
3. Paul, J.K., Noyer., *Genetic Engineering Applications for Industry, Corporation*, New Jersey, 1981.
4. 4. Rehm, H.J. and Reed,G, Verlag Chemie, Wainheim. *Biotechnology*, VI-VIII, 1983.
5. Toledo, R.T., *Fundamentals of Food Process Engineering*, AVI Publishing Co., USA, 1980.

### Course Outcomes

| CO. No | Upon the completion of the course, the students will be able to:   | PSO addressed | Cognitive level |
|--------|--|---------------|-----------------|
| CO1    | Recognize the significance and activities of microorganisms in food and role of intrinsic and extrinsic factors on growth and survival of microorganisms in food and dairy | 1,2           | Understanding   |
| CO2    | Illustrate the spoilage mechanisms in foods and dairy and thus identify methods to control deterioration and spoilage  | 2,5           | Applying        |
| CO3    | Relate awareness in food borne diseases  | 3,2           | Analyzing       |
| CO4    | Rank use of food safety measurement for the quality of food stuffs.  | 5,1           | Evaluating      |
| CO5    | Compose the probiotic its Antibacterial activity and therapeutic property of probiotic cultures.   | 3, 1          | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course         |       |       |       |                                    | Hours | Credit |       |       |  |  |
|---|------------------------------------|-----------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|--|--|
| IV  | 21PCMB41                           | Food and Dairy Microbiology |       |       |       |                                    | 75    | 4      |       |       |  |  |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                             |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |  |  |
|   | PLO 1                              | PLO 2                       | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |  |  |
| CO-1  |                                    | ✓                           |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| CO-2  | ✓                                  | ✓                           |       | ✓     | ✓     | ✓                                  | ✓     | ✓      | ✓     | ✓     |  |  |
| CO-3  | ✓                                  | ✓                           | ✓     |       | ✓     | ✓                                  |       | ✓      |       | ✓     |  |  |
| CO-4  |                                    | ✓                           |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |  |  |
| CO-5  |                                    | ✓                           | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |  |  |
| Number of matches (✓) = 38<br>Relationship = High |                                    |                             |       |       |       |                                    |       |        |       |       |  |  |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – IV

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY</b> |
| Total Hrs           | 75  |
| Hrs/Week            | 5   |
| Sub.Code            | 21PCMB42  |
| Course Type         | DSC 11  |
| Credits             | 4   |
| Marks               | 100   |

### **General Objective:**

The course imparts the role of microbes in industrial production, designing bioreactors and gain knowledge in role of microorganism producing essential components of Pharmacy.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>   |
|---------------|--|
| CO-1          | Express the Historical account of industrial microbiology.   |
| CO-2          | Interpret the information in Microbial production.   |
| CO-3          | Appraise the biopesticides and biofertilizers production and its importance.                       |
| CO-4          | Plan the applications in human therapeutics, antimicrobial agents, and Pharmaceutical Formulation. |
| CO-5          | Compare the types of spoilage, and factors pharmaceutical products.                                |

### **UNIT1: History of Industrial Microbiology (15 hours)**

Historical account of microbes in industrial microbiology, Sources and Characters of industrially potent microbes; their Isolation, Screening and Purification of useful strains; Culture Collections; Primary Screening and Secondary Screening, Strain improvement. Microbial growth kinetics in Batch, Continuous and Fed-batch fermentation process. Bioreactor-Principles and Designing, Types of bioreactors, Types of fermentation process, Primary and Secondary metabolites. Upstream and Downstream processing - methods employed.

### **UNIT II: Microbial Product (15 hours)**

Microbial production of commercially important products: Vitamins (Cyanocobalamine, Riboflavin), Antibiotics (Penicillin, Semisynthetic Penicillin, Streptomycin,), Hormones (Giberllins, Auxins), solvents (Alcohol,

Acetone), enzymes (Microbial Rennets), acids (Lactic acid, Citric acid), enzymes (Protease, Amylase, and Lipase) and Steroid bioconversions. Methods of immobilization and applications. Production of proteins in bacteria and Yeast (Chymosin production) Recombinant and synthetic vaccines.

### **UNIT III: Biopesticides (15 hours)**

Biopesticides – history of development, production of biopesticides from bacteria, fungi and viruses and their applications against different types of pathogens (BT, *Trichoderma viridae*). Biofertilizer production technology-strain selection, sterilization, growth and fermentation, standards and quality control, biofertilizer application technology. Mass production of Biofertilizers (*Rhizobium*, *Azotobacter*); Biopolymers, Single cell protein (Bacteria, fungi etc).

### **UNIT IV: Scope and Applications Therapeutics (15 hours)**

Scope and its applications in human therapeutics, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semi synthetic, Natural - therapeutic agents. Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal. Pharmaceutical Formulation (Tablets, Capsule, Ointments, Syrup, Gel), Stages of Pharmaceutical product Development.

### **UNIT V: Spoilage and Preservation of Pharmaceutical Products (15 hours)**

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Objectives of preservation, the ideal preservative, preservative system etc., Antimicrobial preservatives and their properties. Preservative stability and efficacy.

#### **TEXT BOOKS:**

1. Dubey, R. C. A. *Text Book of Biotechnology*. (4<sup>th</sup> Edition) S. Chand & Company Limited, New Delhi, 2007.
2. Gupta, P.K. *Elements of Biotechnology*. Rastogi Publications, Meerut, 2003.
3. Jogdand, S. N. *Gene Biotechnology*; (5<sup>th</sup> Edition) Himalaya Publishing House, 2000.
4. Reed. G. Prescott and Dunn. *Industrial Microbiology*. Macmillian Publication., 1982.

#### **REFERENCE BOOKS:**

1. Hugo W. B and Russell A.D. *Pharmaceutical Microbiology*. Sixth Edition, The Black well Science Ltd., UK, 1998.
2. Stanbury., P.F.A. Whitaker and Hall. *Principles of Fermentation Technology*, 2002.



### Course Outcomes

| CO. No. | Upon the completion of the course, the students will be able to:  | PSO addressed | Cognitive level |
|---------|---|---------------|-----------------|
| CO1     | Comprehend different fermentation techniques, bioreactor design, inoculum development for industrial fermentations. | 1,2           | Understanding   |
| CO2     | Schedule the industrial production and purification with help of different microbes.                                | 3,4           | Applying        |
| CO3     | Formulate the importance of biofertilizers and biopesticides  | 4,3           | Analyzing       |
| CO4     | Test the industrial production and purification   | 1,5           | Evaluating      |
| CO5     | Choose the substances either of natural or synthetic sources as antimicrobial agents.                               | 2,1           | Creating        |

### Relationship Matrix

| Semester              | Course Code                                       | Title of the Course                        |       |       |       |                                    | Hours | Credit |       |       |
|-----------------------|---|--|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| IV                    | 21PCMB42  | INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY |       |       |       |                                    | 75    | 4      |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)                |  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|                       | PLO 1   | PLO 2                                      | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1                  | ✓   | ✓  |       | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
| CO-2                  | ✓   |  |       | ✓     | ✓     | ✓                                  | ✓     |        |       | ✓     |
| CO-3                  | ✓   | ✓  | ✓     |       | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4                  |   | ✓  |       | ✓     | ✓     | ✓                                  |       | ✓      |       | ✓     |
| CO-5                  | ✓   | ✓  | ✓     | ✓     | ✓     |                                    | ✓     | ✓      | ✓     | ✓     |
|                       | Number of matches (✓) = 37<br>Relationship = High |  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. K. Feroz Khan  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER-IV

| Course Title | RESEARCH PROJECT |
|--------------|------------------|
| Total Hrs    | 120              |
| Hrs/Week     | 8                |
| Sub.Code     | 21PPMB41         |
| Course Type  | DSC12            |
| Credits      | 8                |
| Marks        | 100              |

### General Objective:

The course assists to plan and design statistically to retrieve relevant literature for research project and creates knowledge in evaluating data using statistical methods.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives                             |
|--------|---|
| CO-1   | Review research project individually.         |
| CO-2   | Apply and develop self-confidence.            |
| CO-3   | Analyze the data and writing research papers. |
| CO-4   | Design competence in research.                |
| CO-5   | Rate the research project individually.       |

### RESEARCH PROJECT

To plan and design statistically retrieve relevant literature and to organize and process the data, photograph relevant observations, evaluate using statistical programme, to present the project in any State/ Regional / National conference/ Seminar during the second year of the course and submit during the final semester examinations. The work has to be conducted in the Department / Collaborative organization / Institute under the guidance of the Project Supervisor. Interdisciplinary collaborations from External Departments / Institutions can also be organized for essential areas of the Project if necessary. The method of valuation of the project report submitted by the candidate is outlined under the course project and *viva-voce*.

The project report should be submitted to the Head of the Course Department "One week prior" to the commencement of the practical examination in the Fourth Semester. Each student has to submit 3 copies of his / her project report for evaluation.

## **INDUSTRIAL VISIT**

An educational tour to leading industrial institutes should be conducted as an eye opener and to basically understand the advanced technological know how which is a must. This exposure and orientation to Advanced Instruments / Gadgetries / On-line Process / By-product Recoveries / Involved Strategies and Implications would alleviate the level of scientific knowledge by all standards. A report pertaining to the visit of scientific learning shall be submitted for evaluation. On-Duty leave should be granted to the teachers accompanying the students. The industrial visit shall include Food, Dairy, Pharmaceutical, Biotechnological, Agricultural, Beverage and Fermentation, Enzyme Production, Solid and Liquid Waste Management, processing plants and research based organizations (Fundamental and Advanced Centers of Eminence)

## **PRESENTATION OF SCIENTIFIC FINDINGS**

Each student will have to present their scientific findings of individual work (or) collaborative work in any State / Regional / National International Seminar or Symposia. Alternatively, they can attend any workshops conducted by the State / National Organizations of Scientific Recognition. Abstracts / Papers presented along with certificates will have to be produced during examination. Scientific papers published in Journals / Proceedings during his / her Master Programme will be given special weightage.

## **GENERAL VIVA - VOCE**

The examiners shall conduct a General *Viva-Voce* pertaining to the core course papers as an overall component.

### **Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>  | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|---|-----------------------|------------------------|
| CO-1          | Report the advanced level of information for doing a research project individually.   | 4,3                   | Understanding          |
| CO-2          | Operate self-confidence through paper presentation and skill based training at workshops and gets acquainted to subject interviews. | 5,1                   | Applying               |
| CO-3          | Analyze the skills in writing research papers.  | 1,2                   | Analyzing              |
| CO-4          | Assess use of project study to approach funding agency.   | 5,2                   | Evaluating             |
| CO-5          | Manage competence to plan and create research design.   | 5,4                   | Creating               |

### Relationship Matrix

| Semester              | Course Code                                       | Title of the Course | Hours | Credit |       |                                    |       |       |       |       |
|-----------------------|---|---------------------|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| IV                    | 21PPMB41  | RESEARCH PROJECT    | 120   | 8      |       |                                    |       |       |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)                |                     |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|                       | PLO 1   | PLO 2               | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1                  | ✓   | ✓                   |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| CO-2                  | ✓   | ✓                   |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-3                  |   | ✓                   | ✓     |        | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-4                  | ✓   |                     |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-5                  | ✓   | ✓                   |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
|                       | Number of matches (✓) = 38<br>Relationship = High |                     |       |        |       |                                    |       |       |       |       |

Prepared by  
 Dr. M. Manohar  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – IV

| <b>Course Title</b> | <b>ADVANCES IN BIOTECHNOLOGY</b> |
|---------------------|----------------------------------|
| Total Hrs           | 60                               |
| Hrs/Week            | 4                                |
| Sub.Code            | 21PEMB41A                        |
| Course Type         | DSE                              |
| Credits             | 4                                |
| Marks               | 100                              |

### **General Objective:**

The course creates knowledge on digestive enzymes, vectors, vaccines and recent techniques in Biotechnology.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                                  |
|---------------|---|
| CO-1          | Discuss the fundamental concepts of Biotechnology.        |
| CO-2          | Interpret the Modern trends in the vectors.               |
| CO-3          | Distinguish the genetic transformation in microorganisms. |
| CO-4          | Construct the protein separation and profiling.           |
| CO-5          | Rank the vaccine production and application.              |

### **Unit I: Basics of Biotechnology (12 hours)**

Biotechnology – history, scope and importance of Biotechnology. PCR methods and Applications: PCR methods- Real time PCR, Multiplex PCR, Nested PCR. Molecular markers-RFLP, SSR, RAPD and AFLP analysis.

### **Unit II: Genetic Recombination (12 hours)**

Steps of Genetic Recombination processes -Restriction digestion, ligation, cloning. Cloning Vectors: Definition and Properties, Plasmid vectors: pBR and pUC series, Bacteriophage lambda and M13 vectors, Cosmids, BACs, YACs, Expression vectors: E. coli lac and T7 promoter-based vectors, yeast- YEp and YCp vectors.

### **Unit III: Genomic Techniques: (12 hours)**

Transformation of DNA: Chemical method, Electroporation. Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery, Agrobacterium - mediated delivery. Hybridization -Southern for genome analysis.

#### **Unit IV: Proteomics (12 hours)**

Protein separation: Single dimensional and two dimensional gel electrophoresis. Detection of protein: Organic dye staining - silver staining - fluorescent staining - image analysis. Protein arrays: Definition - diagnostics expression profiling and applications. Exoproteome analysis.

#### **Unit V: Applications of recombinant technology (12 hours)**

Applications of recombinant technology: Recombinant therapeutic proteins-insulin and Follicle Stimulating Hormone (FSH). Recombinant vaccines: Hepatitis-B vaccine. Genetic engineering of plants: Insecticide - herbicide resistant crops. Gene targeting for gene therapy: CRISPR – Cas system. Synthetic biology: Artificial cells. Ethics in Biotechnology and intellectual property rights (IPR).

#### **TEXT BOOKS:**

1. DAS, H.K. *A Text Book of Biotechnology*, Revised Edition, Wiley publications Ltd., New Delhi, 2010.
2. Glick, B.R., and J.J. Pasternak, 2003. *Molecular Biotechnology*. ASM Press; Washington D.C.
3. Nicholl D. S. T. 2008. *An Introduction to Genetic Engineering*, Cambridge University Press

#### **REFERENCE BOOKS:**

1. Friedberg, C. Graham C. Walker and S. Wolfram Siede, Richard. *DNA Repair and Mutagenesis*. ASM Publications, 1995.
2. Larry, S. and Wendy. *Molecular Genetics of Bacteria*. ASM Publications, 1997.
3. Lewin. *Gene*. VII edition. Oxford University y Press, 2000.
4. Maloy. *Microbial Genetics*. Jones and Bartlett Publishers. Dale J. W. 1994.
5. Streips and Yasbin. *Modern Microbial Genetics*. John Wiley and Sons. Niley Ltd; 1991.
6. Watson J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner, *Molecular Biology of the Gene*. Benjamin / Cummings Publications Co. Inc. California, 1987.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Identify the basics and concept of biotechnological terms.   | 1,3            | Understanding   |
| CO-2   | Apply importance of PCR and vector.  | 4,2            | Applying        |
| CO-3   | Analyse the protein arrays.  | 1,5            | Analyzing       |
| CO-4   | Combine the proteomic technique.   | 4,2            | Evaluating      |
| CO-5   | Appraise the application of biotechnology in medical and its allied fields, gene therapy, genetic counselling. | 4,1            | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course       |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|---------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| IV  | 21PEMB41A                          | ADVANCES IN BIOTECHNOLOGY |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                           |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2                     | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  |                           | ✓     | ✓     | ✓     |                                    |       | ✓      | ✓     | ✓     |
| CO-2  | ✓                                  | ✓                         | ✓     | ✓     | ✓     | ✓                                  | ✓     | ✓      | ✓     | ✓     |
| CO-3  | ✓                                  | ✓                         |       | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4  |                                    | ✓                         | ✓     | ✓     | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-5  | ✓                                  |                           | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| Number of matches (✓) = 40<br>Relationship = High |                                    |                           |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – IV

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>VERMI TECHNOLOGY AND MUSHROOM CULTIVATION</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PEMB41B  |
| Course Type         | DSE  |
| Credits             | 4  |
| Marks               | 100  |

### General Objective:

Acquired skills and an initial understanding of recent developments of Vermi Technology and Mushroom Cultivation.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the vermi composting and mushroom cultivation for Entrepreneurship |
| CO-2          | Interpret the concept and skill in the techniques of vermi composting.        |
| CO-3          | Analyze the knowledge on different types of mushroom                          |
| CO-4          | Evaluate the different types of mushroom and its uses.                        |
| CO-5          | Create awareness about the medicinal and nutritive value of mushrooms.        |

### UNIT-I: Classification of Earthworm (12 hours)

Earthworm Classification – Morphology and Anatomy. Biology of *Lampitomaruitii*. Vermicomposting - Definition, Introduction and Scope- The nature of earthworms-soil environment-basic environmental requirements.

### UNIT-II: Vermicompost and its types (12 hours)

Vermicomposting materials and their Classification, Physical, chemical and biological changes brought by earthworm in Soil Structure - Carbon, Nitrogen and Phosphorous transformations. Vermicomposting methods - Optimal conditions for Vermiculture - temperature, moisture, pH, soil type, organic matter, Vermicomposting in Homes, Maintenance of vermicomposting beds. Harvesting the worms. Earthworm predators, parasites and pathogens. Vermiwash, Applications of vermicomposting.

### UNIT-III: Mushroom Technology (12 hours)

Mushroom Technology - Introduction, History and Scope –Morphology of mushroom -Vegetative characters - Formation and development of Basidiocarp, Structure of basidiocarp - *Agaricus*. Edible and Poisonous



Mushrooms. Medicinal and nutritive value of edible mushrooms. Food preparation- soup, cutlet, vegetable curry, samosa, omlette and pickle. Mushroom research centers in India.

#### **UNIT-IV: Cultivation of mushroom (12 hours)**

Cultivation of button mushroom (*Agaricus bisporus*), milky mushroom (*Calocybe indica*), oyster mushroom (*Pleurotussajor caju*) and paddy straw mushroom (*Volvariella volvcea*).Preparation of Pure Culture and spawn cultivation methods.

#### **UNIT-V: Cultivation technology (12 hours)**

Cultivation technology - Substrates, Bed, Polythene- Bag preparation, spawning - casing - Cropping - Mushroom production - Harvest - Storage methods and marketing. Post harvest technology: Storage-Freezing, dry Freezing, drying, canning.

#### **Text Books:**

1. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.
2. Ranganathan L.S. 2006. Vermibiotechnology from soil health to human health. Agrobios India.
3. Gupta P.K. 2008. Vermicomposting for sustainable agriculture. Agrobios. India.

#### **Reference Books:**

1. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3rd Edition, Chapman and hall.
2. Jsmail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.

#### **Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>   | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Analyse the Morphology and Anatomy. Biology of Earthworms  | 1,3                   | Analyzing              |
| CO-2          | Infer the Vermicomposting materials and their Classification.                                      | 3,4                   | Understanding          |
| CO-3          | Evaluate the Morphology, vegetative characters,formation and development of basidiocarpof mushroom | 1,2                   | Evaluating             |
| CO-4          | Classify the Cultivation of button mushroom and milky mushroom                                     | 4,5                   | Analyzing              |
| CO-5          | Develop the knowledge in Cultivation technology of mushroom  | 4,5                   | Creating               |

### Relationship Matrix

| Semester                    | Course Code                                       | Title of the Course                                      |       |       |       |                                       | Hours     | Credit   |       |       |  |
|-----------------------------|---|--|-------|-------|-------|---------------------------------------|-----------|----------|-------|-------|--|
| <b>IV</b>                   | <b>21PEM41B</b>                                   | <b>VERMI TECHNOLOGY<br/>AND MUSHROOM<br/>CULTIVATION</b> |       |       |       |                                       | <b>60</b> | <b>4</b> |       |       |  |
| Course<br>Outcomes<br>(COs) | Programme Learning<br>Outcomes (PLOs)             |  |       |       |       | Programme Specific<br>Outcomes (PSOs) |           |          |       |       |  |
|                             | PLO 1   | PLO 2  | PLO 3 | PLO 4 | PLO 5 | PSO 1                                 | PSO 2     | PSO 3    | PSO 4 | PSO 5 |  |
| CO-1                        | ✓   | ✓  | ✓     | ✓     | ✓     | ✓                                     |           | ✓        | ✓     | ✓     |  |
| CO-2                        |   | ✓  | ✓     | ✓     | ✓     |                                       | ✓         | ✓        |       | ✓     |  |
| CO-3                        | ✓   | ✓  |       | ✓     |       | ✓                                     | ✓         |          | ✓     |       |  |
| CO-4                        | ✓   |  | ✓     |       | ✓     |                                       | ✓         | ✓        | ✓     | ✓     |  |
| CO-5                        | ✓   | ✓  | ✓     | ✓     | ✓     | ✓                                     | ✓         | ✓        | ✓     | ✓     |  |
|                             | Number of matches (✓) = 39<br>Relationship = High |  |       |       |       |                                       |           |          |       |       |  |

Prepared by  
 Dr. M. Suriya Prabha  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

## SEMESTER – IV

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>ENVIRONMENT AND WASTE MANAGEMENT</b> |
| Total Hrs           | 60                                      |
| Hrs/Week            | 4                                       |
| Sub.Code            | 21PEMB41C                               |
| Course Type         | DSEC 4                                  |
| Credits             | 4                                       |
| Marks               | 100                                     |

### General Objective

Acquired skills, understanding different environment, pollution and waste management.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>  |
|---------------|---|
| CO-1          | Understand the Soil profile and soil microflora.  |
| CO-2          | Interpret the concept Solid waste management methods, land filling and recycling.               |
| CO-3          | Analyze the types and major sources of air pollutants   |
| CO-4          | Evaluate the International Programme on Chemical Safety.  |
| CO-5          | Create an awareness about degradation of common pesticides, organic hydrocarbons and oil spills |

### UNIT I: Terrestrial Environment (12 hours)

Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes. Animal Environment: Microbes in/on human body (microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrastatic & osmotic pressures, salinity, & low nutrient levels.

### UNIT II: Solid wastes (12 hours)

Sources, generation, classification & composition of solid wastes. Solid waste management methods - Sanitary land filling, Recycling, Composting, Vermi composting, Incineration, energy recovery from organic waste.

### UNIT III: Environmental Pollution and its types (12 hours)

Types and major sources of air pollutants, effects of air pollutants on physico-chemical and biological properties surrounding atmosphere, air born diseases. Types and major sources of water pollutants, effects of water

pollutants on physico-chemical and biological properties of water bodies, water born diseases with special reference to water pollution. Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil.

#### **UNIT IV: Environmental health Management (12 hours)**

Scope of International Programme on Chemical Safety (IPCS). Effects of mercury, lead, chromium, cadmium, arsenic and nitrate on human health. Water borne diseases; Prevention and protection of community health from water borne diseases. Air borne bio-allergents; present in the ambient air, seasonal changes, mode of dispersal, disease intensity and control.

#### **UNIT V: Degradation of pesticides (12 hours)**

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

#### **TEXT BOOKS**

1. Shiva Aithal, C. (2010). Modern approaches in Soil, Agricultural and Environmental Microbiology. Himalaya Publishers, New Delhi.
2. Atlas, R.M., and Bartha, M. (2003). Microbial Ecology – Fundamentals and applications. Benjamin – Cummings, Menlo Park, California.
3. Martin Alexander (1983). Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.
4. Subba Rao, N.S. (1997). Biofertilizers in Agriculture and Forestry III Ed, Oxford and IBH Publishing Co, Pvt. Ltd, New Delhi.
5. Subba Rao, N.S. (1995). Soil Microorganisms and Plant growth. Ed, Oxford and IBH Publishing Co, Pvt. Ltd, New Delhi

#### **REFERENCE BOOKS:**

1. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
2. Rangaswamy. G., and Bagyaraj, D.J. (1996). Agricultural Microbiology. Prentice- Hall of India Pvt Ltd., New Delhi.
3. Dirk, J. Elsas, V., Trevors, T., and Wellington, E.M.H. (1997). Modern Soil Microbiology. , Marcel Dekker INC, New York, Hong Kong.
4. Dubey R.C. (2001). A Text Book of Biotechnology. S Chand & Co. New Delhi.

### Course Outcomes

| CO No. | Course Outcomes  | PSOs Addressed | Cognitive Level |
|--------|--|----------------|-----------------|
| CO-1   | Analyse the aeromicroflora and dispersal of microbes.                              | 1              | Analyzing       |
| CO-2   | Infer the sources, generation, classification & composition of solid wastes.       | 3              | Understanding   |
| CO-3   | Evaluate the different Environmental Pollution and its impacts                     | 1              | Evaluating      |
| CO-4   | Classify the Environmental health Management                                       | 4              | Analyzing       |
| CO-5   | Develop the knowledge in Treatment and safety of drinking (potable) water samples. | 4              | Creating        |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course              |       |       |       |                                    | Hours | Credit |       |       |
|---|------------------------------------|----------------------------------|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| IV  | 21PEM41C                           | ENVIRONMENT AND WASTE MANAGEMENT |       |       |       |                                    | 60    | 4      |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |                                  |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|   | PLO 1                              | PLO 2                            | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1  | ✓                                  | ✓                                |       | ✓     |       | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-2  |                                    | ✓                                | ✓     | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
| CO-3  | ✓                                  | ✓                                |       |       |       | ✓                                  |       | ✓      | ✓     |       |
| CO-4  | ✓                                  |                                  |       | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |
| CO-5  | ✓                                  | ✓                                | ✓     | ✓     | ✓     | ✓                                  | ✓     | ✓      |       | ✓     |
| Number of matches (✓) = 39<br>Relationship = High |                                    |                                  |       |       |       |                                    |       |        |       |       |

Prepared by  
Dr. M. Suriya Prabha  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department

## SEMESTER-IV

|                     |  |
|---------------------|--|
| <b>Course Title</b> | <b>TECHNIQUES IN FOOD AND DAIRY MICROBIOLOGY</b> |
| Total Hrs           | 60   |
| Hrs/Week            | 4  |
| Sub.Code            | 21PCMB4P1  |
| Course Type         | DSCP VII   |
| Credits             | 2  |
| Marks               | 50   |

### General Objective:

The course gives practice to isolate and to identify food borne pathogens and food beverages.

**Course Objectives:** The learners will be able to:

| CO No. | Course Objectives   |
|--------|---|
| CO-1   | Report and confirmation of <i>Salmonella</i> sp and <i>Shigella</i> sp in beverages |
| CO-2   | Practice and identify yeast from Idly batter  |
| CO-3   | Analyze the Bacteria from spoiled fruit.  |
| CO-4   | Collect the microbial load in spoiled meat.   |
| CO-5   | Compare the quality of milk   |

1. Detection and confirmation of *Salmonella* sp and *Shigella* sp in beverages.
2. Isolation and identification of yeast from Idly batter.
3. Isolation and identification of Bacteria from spoiled fruit.
4. Isolation and identification of Bacteria from spoiled Vegetable.
5. Isolation and identification of Bacteria from spoiled meat.
6. Isolation and identification of *Vibrio* species from fish product..
7. Wet mount Preparation spoiled bread, grapes.
8. Determination of quality of milk-Methylene Blue Reduction Test (MBRT).
9. Resazurin test of milk.
10. Phosphatase Test.

**TEXT BOOKS:**

1. Cappuccino, J.G. and N. Sherman. *Microbiology: A Laboratory Manual*. 10<sup>th</sup> Edition. Pearson education Limited. 2014.
2. Doyle, M.P. and L.R. Beuchat. *Food Microbiology: Fundamentals and Frontiers*, 3ed, 2002.
3. Kannan. *Laboratory Manual in General Microbiology*. Palani Paramount Publications, Palani, 1996.

**REFERENCE BOOKS:**

1. Adams, M.R. and M.O. Moss. *Food Microbiology*, 2ed (Royal Society of Chemistry); 2000.
2. Knorr, D., Food Biotechnology. Marcel Dekker, New York, 1982.
3. Rehm, H.J. and G, Reed. Biotechnology, VI-VIII, Verlag Chemie, Wainheim, 1983.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>   | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Summarize the procedure for Isolation and identification of microorganisms from various foods. | 1,2                   | Understanding          |
| CO-2          | Examine the quality of milk by applying Methylene Blue Reduction Test.                         | 3,4                   | Applying               |
| CO-3          | Analyze the methods on wet mount preparation of spoiled bread and grapes.                      | 1,5                   | Analyzing              |
| CO-4          | Determine the quality milk by Phosphatase Test.  | 4,5                   | Evaluating             |
| CO-5          | Choose the bacteria from various spoiled food samples.   | 1,3                   | Creating               |

### Relationship Matrix

| Semester  | Course Code                        | Title of the Course                                      | Hours | Credit |       |                                    |       |       |       |       |
|---|------------------------------------|--|-------|--------|-------|------------------------------------|-------|-------|-------|-------|
| IV  | 21PCMB4P1                          | <b>TECHNIQUES IN FOOD<br/>AND DAIRY<br/>MICROBIOLOGY</b> | 60    | 2      |       |                                    |       |       |       |       |
| Course Outcomes (COs)                             | Programme Learning Outcomes (PLOs) |  |       |        |       | Programme Specific Outcomes (PSOs) |       |       |       |       |
|   | PLO 1                              | PLO 2  | PLO 3 | PLO 4  | PLO 5 | PSO 1                              | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
| CO-1  | ✓                                  | ✓  |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| CO-2  | ✓                                  | ✓  |       | ✓      | ✓     | ✓                                  | ✓     |       | ✓     | ✓     |
| CO-3  | ✓                                  | ✓  | ✓     |        | ✓     | ✓                                  |       | ✓     | ✓     | ✓     |
| CO-4  | ✓                                  | ✓  |       | ✓      | ✓     |                                    | ✓     |       | ✓     | ✓     |
| CO-5  | ✓                                  | ✓  |       | ✓      | ✓     |                                    | ✓     | ✓     | ✓     | ✓     |
| Number of matches (✓) = 39<br>Relationship = High |                                    |  |       |        |       |                                    |       |       |       |       |

Prepared by  
Dr. M. Manohar  
Name and Signature

Checked by  
Dr. R. Janet Rani  
Head of the Department



## SEMESTER-IV

|                     |   |
|---------------------|---|
| <b>Course Title</b> | <b>TECHNIQUES IN INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY</b> |
| Total Hrs           | 60  |
| Hrs/Week            | 4   |
| Sub.Code            | 21PCMB4P2   |
| Course Type         | DSCP VIII   |
| Credits             | 2   |
| Marks               | 50  |

### General Objective:

The course creates practical skill on industrially important micro organisms and bioassay of various antibiotics.

**Course Objectives:** The learners will be able to:

| <b>CO No.</b> | <b>Course Objectives</b>                                     |
|---------------|--|
| CO-1          | Identify and confirm industrially important micro organisms. |
| CO-2          | Apply immobilization technique for an enzyme or cell.        |
| CO-3          | Categorize the Solubility of drug at room temperature.       |
| CO-4          | Design the Sterility testing of Pharmaceutical products.     |
| CO-5          | Rate the Microbiological assay of antibiotics.               |

1. Isolation and identification of industrially important micro organisms- crowded plate technique-giant colony technique.

2. Ethanol Fermentation.

3. Immobilization of an enzyme or Cell.

4. Production of Streptomycin (DEMO).

5. Production of Beer (DEMO).

6. Production of Wine (DEMO).

7. Determination of Solubility of drug at room temperature.

8. Sterility testing of Pharmaceuticals.

9. Microbiological assay of antibiotics by cup plate method.

10. Bioassay of chloramphenicol by plate assay method and turbidimetric Assay method.

**REFERENCE BOOKS:**

1. Aneja, K.R., *Experiments in Microbiology, Plant Pathology and Tissue Culture*. Wishwa Prakashan; New Delhi, India. 1993.
2. Benson. *Microbiological Applications – Laboratory Manual in General Microbiology*. International Edition, McGraw Hill Higher Education, 2002.
3. Dubey, R.C. and D.K. Maheswari. *Practical Microbiology*, 1<sup>st</sup> Edition Chand & Company Ltd., India,2002.
4. Gunasekaran, P. *Laboratory Manual in Microbiology*. New Age International Ltd., Publishers, New Delhi, 1996.
5. Jayaraman, J. *Laboratory Manual in Biochemistry*. Wiley Eastern Ltd., New Delhi. 1985.
6. Plummer. D.T. *An Introduction to Practical Biochemistry*. Tata McGraw Hill, New Delhi, 1998.

**Course Outcomes**

| <b>CO No.</b> | <b>Course Outcomes</b>   | <b>PSOs Addressed</b> | <b>Cognitive Level</b> |
|---------------|--|-----------------------|------------------------|
| CO-1          | Cognize and review the sterility test of pharmaceuticals.                  | 1,2                   | Understanding          |
| CO-2          | Exhibit the microbiological assay of antibiotics using cup plate method.   | 1,3                   | Applying               |
| CO-3          | Correlate the knowledge on production of Streptomycin.                     | 3,4                   | Analyzing              |
| CO-4          | Assess the technique for Beer production                                   | 3,5                   | Evaluating             |
| CO-5          | Design Bioassay of chloramphenicol by plate and turbidimetric Assay method | 1,5                   | Creating               |

### Relationship Matrix

| Semester              | Course Code                                      | Title of the Course   |       |       |       |                                    | Hours | Credit |       |       |
|-----------------------|--|---|-------|-------|-------|------------------------------------|-------|--------|-------|-------|
| IV                    | 21PCMB4P2  | <b>TECHNIQUES IN INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY</b> |       |       |       |                                    | 60    | 2      |       |       |
| Course Outcomes (COs) | Programme Learning Outcomes (PLOs)               |   |       |       |       | Programme Specific Outcomes (PSOs) |       |        |       |       |
|                       | PLO 1  | PLO 2   | PLO 3 | PLO 4 | PLO 5 | PSO 1                              | PSO 2 | PSO 3  | PSO 4 | PSO 5 |
| CO-1                  | ✓  | ✓   | ✓     | ✓     | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-2                  |  | ✓   | ✓     |       | ✓     | ✓                                  | ✓     |        | ✓     | ✓     |
| CO-3                  | ✓  | ✓   | ✓     |       | ✓     | ✓                                  |       | ✓      | ✓     | ✓     |
| CO-4                  | ✓  |   |       | ✓     | ✓     |                                    | ✓     |        | ✓     | ✓     |
| CO-5                  | ✓  | ✓   |       | ✓     | ✓     |                                    | ✓     | ✓      |       | ✓     |
|                       | Number of matches (✓) =37<br>Relationship = High |   |       |       |       |                                    |       |        |       |       |

Prepared by  
 Dr. K. Feroz Khan  
 Name and Signature

Checked by  
 Dr. R. Janet Rani  
 Head of the Department

| SEM | Category     | Title of the Courses  | S. Code   | H/W | L | T | P | C | Marks            |                |  |
|-----|--------------|---|-----------|-----|---|---|---|---|------------------|----------------|--|
|     |              |   |           |     |   |   |   |   | I                | E              |  |
| I   | DSC-I        | General Microbiology and Bacteriology                                 | 21PCMB11  | 5   | 4 | 1 |   | 4 | Corrections Done | No Corrections |  |
|     | DSC-II       | Techniques in Microbiology  | 21PCMB12  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSC-III      | Microbial Diversity and Classification                                | 21PCMB13  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSE-IA       | Agricultural Environmental and Marine Microbiology                    | 21PEMB11A | 4   | 3 | 1 |   | 4 |                  |                |  |
|     | DSE-IB       | Advance Microbiology  | 21PEMB11B |     |   |   |   |   |                  |                |  |
|     | DSE-IC       | Bioethics, Biosafety and Intellectual Property Rights                 | 21PEMB11C |     |   |   |   |   |                  |                |  |
|     | P-I          | Techniques in Bacteriology  | 21PCMB1P1 | 4   |   |   |   | 4 | 2                |                |  |
|     | P-II         | Techniques in Agricultural, Environmental and Marine Microbiology     | 21PCMB1P2 | 4   |   |   |   | 4 | 2                |                |  |
|     | IDC          | Microbiology and Human Health   | 21PIMB11  | 2   |   |   |   |   | 2                |                |  |
|     | Library Hour |   | 1         |     |   |   |   | - |                  |                |  |
| II  | DSC-IV       | Microbial Biochemistry  | 21PCMB21  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSC-V        | Microbial Physiology and Metabolism                                   | 21PCMB22  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSC-VI       | Molecular Biology and Genetic Engineering                             | 21PCMB23  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSE-IIA      | Virology  | 21PEMB21A | 4   | 3 | 1 |   | 4 |                  |                |  |
|     | DSE-IIB      | Food Safety, Quality Control And Sensory Evaluation                   | 21PEMB21B |     |   |   |   |   |                  |                |  |
|     | DSE-IIC      | Fermentation Technology   | 21PEMB21C |     |   |   |   |   |                  |                |  |
|     | P-III        | Techniques in Microbial physiology                                    | 21PCMB2P1 | 4   |   |   |   | 4 | 2                |                |  |
|     | P-IV         | Techniques in biochemistry, molecular biology and genetic engineering | 21PCMB2P2 | 4   |   |   |   | 4 | 2                |                |  |
|     | SEC          | SEC-I (MOOC NPTEL Course)   | 21PSMB21  | 2   |   |   |   |   | 2                |                |  |
|     | Library Hour |   | 1         |     |   |   |   | - |                  |                |  |
| III | DSC-VII      | Immunology  | 21PCMB31  | 5   | 4 | 1 |   | 4 |                  |                |  |
|     | DSC-VIII     | Medical Microbiology  | 21PCMB32  | 5   | 4 | 1 |   | 4 |                  |                |  |

|    |           |   |           |   |   |   |  |   |   |   |  |
|----|-----------|---|-----------|---|---|---|--|---|---|---|--|
|    | DSC-IX    | Research Methodology and Biostatistics                      | 21PCMB33  | 5 | 4 | 1 |  | 4 |   |   |  |
|    | DSE-III A | Quality assurance in Microbiology                           | 21PEMB31A | 4 | 3 | 1 |  | 4 |   |   |  |
|    | DSE-III B | Forensic Microbiology                                       | 21PEMB31B |   |   |   |  |   |   |   |  |
|    | DSE-III C | Vertinary Microbiology                                      | 21PEMB31C |   |   |   |  |   |   |   |  |
|    | P-V       | Techniques in Immunology and Research Methodology           | 21PCMB3P1 | 4 |   |   |  | 4 | 2 |   |  |
|    | P-VI      | Techniques in Medical and Quality assurance in Microbiology | 21PCMB3P2 | 4 |   |   |  | 4 | 2 |   |  |
|    | IDC-II    | Entrepreneurship in Microbiology                            | 21PIMB31  | 2 |   |   |  |   | 2 |   |  |
|    |           | Library Hour  |           | 1 |   |   |  |   | - |   |  |
| IV | DSC-X     | Food and Dairy Microbiology                                 | 21PCMB41  | 5 |   |   |  |   | 4 |   |  |
|    | DSC-XI    | Industrial and Pharmaceutical Microbiology                  | 21PCMB42  | 5 |   |   |  |   | 4 |   |  |
|    | P         | Project   | 21PPMB41  | 8 |   |   |  |   | 8 |   |  |
|    | DSE-IV A  | Advances in Biotechnology                                   | 21PEMB41A | 4 | 3 | 1 |  | 4 |   |   |  |
|    | DSE-IV B  | Vermiculture Techniques and Mushroom Technology             | 21PEMB41B |   |   |   |  |   |   |   |  |
|    | DSE-IV C  | Environment and waste Management                            | 21PEMB41C |   |   |   |  |   |   |   |  |
|    | P-VII     | Techniques in Food and Dairy Microbiology                   | 21PCMB4P1 | 4 |   |   |  |   | 4 | 2 |  |
|    | P-VIII    | Techniques in Industrial and Pharmaceutical Microbiology    | 21PCMB4P2 | 4 |   |   |  |   | 4 | 2 |  |

**\* Please, tick (✓ ) the appropriate remark for each course**