

## SEMESTER I

### FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U1R3MBCC1                  | <b>Credit:</b> 5                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 5, <b>Total Inst. Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

#### Course Objectives

1. Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
2. Describe the structural organization, morphology and reproduction of microbes.
3. Explain the methods of cultivation of microbes and measurement of growth.
4. Understand the microscopy and other basic laboratory techniques – culturing, disinfection and sterilization in Microbiology.
5. Compare and contrast the different methods of sterilization.

#### Unit I:

15 hrs

History and Evolution of Microbiology, Classification – Three kingdom, five kingdom, six kingdom and eight kingdom. Microbial biodiversity: Introduction to microbial biodiversity- ecological niche. Basic concepts of Eubacteria, Archaeobacteria and Eucarya. Conservation of Biodiversity.

#### Unit II:

15 hrs

General characteristics and classification of cellular microorganisms (Bacteria - Bergy's manual (classification) Determinative Bacteriology- 9<sup>th</sup> Edition), Fungi (Alexopoulos), Algae (Fritch 1935) and Protozoa (Levine 1980) and acellular microorganisms - (Viruses, Viroids, Prions). Structure of Bacterial cell wall, cell membrane, capsule, flagella, pili, mesosomes, chlorosomes, phycobilisomes, spores, and gas vesicles.

#### Unit III:

15hrs

Differences between prokaryotic and eukaryotic microorganisms. Structure of fungi (Mold and Yeast), Structure of microalgae. Bacterial culture media and pure culture techniques. Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.

#### Unit IV:

15 hrs

Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM, Confocal microscopy, and Atomic Force Microscopy. Stains and staining methods.

#### Unit V:

15 hrs

Sterilization—moist heat - autoclaving, dry heat – Hot air oven, radiation – UV, Ionization, filtration – membrane filter and disinfection, antiseptic; Antimicrobial agents.

| Course Outcomes |                                                                                                                                   |                |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------|
| CO              | On completion of this course, students will;                                                                                      |                |
| CO1             | Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms.       | PO5, PO6, PO10 |
| CO2             | Gain Knowledge of detailed structure and functions of prokaryotic cell organelles.                                                | PO10           |
| CO3             | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | PO11           |
| CO4             | Explain the principles and working mechanism of different microscopes/ Microscope, their function and scope of application.       | PO4, PO11      |
| CO5             | Understand the concept of asepsis and modes of sterilization and disinfectants.                                                   | PO4, PO11      |

### Text Books

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition.,McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson.
4. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7thEdition., McGraw Hill Inc.New York.
5. Boyd, R.F. (1998). General Microbiology,2ndEdition., Times Mirror, Mosby CollegePublishing, St Louis.

### Reference Books

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones &Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd
3. Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11thEdition., Benjamin Cummings.
4. Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5thEdition., McGraw Hill Publications.
5. Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co.

## Web Resources

1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>
2. <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#>
4. <https://bio.libretexts.org/@go/page/9188>
5. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/>

## Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     |     | M   | M   |     |     |     | M    |      |
| CO2 |     |     |     |     |     |     |     |     |     | M    | M    |
| CO3 |     |     |     |     |     |     |     |     |     |      | S    |
| CO4 |     |     |     | M   |     |     |     |     |     |      | S    |
| CO5 |     |     |     | M   |     |     |     |     |     |      | S    |

## PRACTICAL I - FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| <b>Course Code:</b> U1R3MBCC2P                 | <b>Credit:</b> 5                     |
| <b>Category:</b> Core Course – Practical I     | <b>Hrs/Week:</b> 5                   |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40+ EXT: 60 = 100 |

### Course Objectives

1. Acquire knowledge on Cleaning of glass wares, GLP and sterilization.
  2. Gain knowledge on media preparation and cultural characteristics.
  3. Learn the pure culture technique
  4. Learn the microscopic techniques and staining methods.
  5. Acquire knowledge on stain and staining methods
1. Microbiological good laboratory practice and safety.
  2. Cleaning of glass wares.
  3. Sterilization and assessment of sterility– Autoclave, hot air oven, and membrane filtration.
  4. Media preparation: liquid media, solid media, semi-solid media, agar slants, agar deeps, agar plates.
  5. Preparation of basal, differential, enriched, and enrichment media.
    - (i) Transport, and selective media preparation
    - (ii) Quality control of media
    - (iii) Growth supporting properties, sterility check of media
    - (iv) Serial dilution technique
  6. Pure culture techniques: streak plate, pour plate.
  7. Culture characteristics of microorganisms: growth on different media, growth characteristics, and description.
  8. Demonstration of pigment production.
  9. Microscopy: light microscopy and bright field microscopy.
  10. Staining techniques: smear preparation, simple staining, Gram's staining and endospore staining.
  11. Study on Microbial Diversity using Hay Infusion Broth
  12. Wet mount to show different types of microbes
  13. Hanging drop.

| Course Outcomes |                                                                                        |                          |
|-----------------|----------------------------------------------------------------------------------------|--------------------------|
| CO              | On completion of this course, students will;                                           |                          |
| CO1             | Practice sterilization methods; learn to prepare media and their quality control.      | PO4, PO7, PO8, PO9, PO11 |
| CO2             | Learn streak plate, pour plate and serial dilution and pigment production of microbes. | PO4, PO7, PO8, PO9       |
| CO3             | Understand Microscopy methods, different Staining techniques and motility test.        | PO4, PO7, PO8, PO9, PO11 |
| CO4             | Observe culture characteristics of microorganisms.                                     | PO4, PO7, PO8, PO9       |
| CO5             | Study on Microbial Diversity using Hay Infusion Broth-Wet mount                        | PO4, PO7, PO8, PO9       |

### Text Books

1. James G Cappucino and N. Sherman MB(1996). A lab manual Benjamin Cummins, New York 1996.
2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
5. R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing.

### Reference Books

1. Atlas.R (1997). Principles of Microbiology, 2nd Edition, Wm.C.Brown publishers.
2. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India
3. Talib VH (2019). Handbook Medical Laboratory Technology. (2nd Edition). CBS
4. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5. Lim D. (1998). Microbiology, 2ndEdition, WCB McGraw Hill Publications.

### Web Resources

1. <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.
2. <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
3. [https://www.grsmu.by/files/file/university/cafedry//files/essential\\_microbiology.pdf](https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf)
4. <https://microbiologyinfo.com/top-and-best-microbiology-books/>
5. <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>.

**Mapping with Programme Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     | M   |     |     | L   | M   | L   |      | M    |
| CO2 |     |     |     | S   |     |     | L   | L   | L   |      |      |
| CO3 |     |     |     | S   |     |     | M   | M   | L   |      | M    |
| CO4 |     |     |     | S   |     |     | M   | L   | L   |      |      |
| CO5 |     |     |     | S   |     |     | M   | L   | L   |      |      |

## BASIC AND CLINICAL BIOCHEMISTRY

|                                                 |                                                |
|-------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U1R3MBDSE1                  | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective-I | <b>Hrs/Week:</b> 4, <b>Total Inst. Hrs:</b> 60 |
| <b>Nature of the Course:</b> Employability      | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

### Course Objectives

1. Attain thorough knowledge on carbohydrates and lipids, their characteristic properties and organization in carrying out all the living functions which constitute the life.
2. Explain the biological activity of amino acids and proteins.
3. Identify the metabolic errors in enzymes of carbohydrates and lipids.
4. Describe the disorders in amino acid metabolism.
5. Interpret the consequences, biochemical, clinical features, diagnosis and treatment of metabolic diseases of day today life.
- 6.

#### Unit I:

12 hrs

**Biomolecules -Carbohydrate** – General properties, function, structure, classification– monosaccharides (Glucose, Fructose, Galactose), Oligoaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and **biological significance**. Lipids – General properties, functions, structure, classification (Simple, Derived and Complex), **Cholesterol, LDL, HDL – biological significance**.

#### Unit II:

12 hrs

**Biomolecules - Amino acids** – General properties, functions, structure, classification and biological significance. Proteins– General structure, Properties, functions, classification and biological significance.

#### Unit III:

12 hrs

Disorders of Metabolism: **Disorders of carbohydrate metabolism:** diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. **Disorders of lipid metabolism:** hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.

#### Unit IV:

12 hrs

Disorders of Metabolism: **Disorders of amino acid metabolism:** alkaptonuria, phenylketonuria, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias.

#### Unit V:

12 hrs

**Evaluation of organ function tests:** Assessment and clinical manifestations of renal, hepatic, pancreatic, gastric and intestinal functions. **Diagnostic enzymes:** Principles of diagnostic enzymology. Clinical

significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase.

| <b>Course Outcomes</b> |                                                                                                                                                                                                                                                                      |               |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>CO</b>              | <b>On completion of this course, students will;</b>                                                                                                                                                                                                                  |               |
| CO1                    | Explain the structure, classification, biochemical functions and significance of carbohydrates and lipids                                                                                                                                                            | PO1           |
| CO2                    | Differentiate essential and non-essential amino acids, biologically important modified amino acids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation. | PO1           |
| CO3                    | Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.                                                                                                                                                         | PO4, PO5, PO6 |
| CO4                    | Discuss and evaluate the pathology of amino acid metabolic disorders.                                                                                                                                                                                                | PO4, PO5, PO6 |
| CO5                    | Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.                                                                                                                                        | PO5, PO6, PO9 |

### **Text Books**

1. Satyanarayana, U. and Chakrapani, U(2014).Biochemistry,4th Edition, Made Simple Publisher.
2. Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7th Edition, S Chand Company.
3. Ambika Shanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8th Edition. Wolters Kluwer India Pvt Ltd.
4. Vasudevan. D.M.Sreekumari.S, Kannan Vaidyanathan (2019). Textbook Of Biochemistry For Medical Students. Kindle edition, Jaypee Brothers Medical Publishers
5. Jeremy M. Berg, LubertStryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8th edition. WH Freeman publisher.

### **Reference Books**

1. AmitKessel&Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2<sup>nd</sup> Edition, Chapman and Hall.
2. David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry, 7thEdition W.H. Freeman and Co., NY.
3. Lupert Styrrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9thEdition ,W.H. Freeman& Co. New York.
- 4.. Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5th Edition, Wiley.
5. Joy PP, Surya S. and AswathyC (2015). Laboratory Manual of Biochemistry, Edition 1., Publisher: Kerala agricultural university.

### Web Resources

1. <https://www.abebooks.com> > plp
2. <https://kau.in/document/laboratory-manual-biochemistry>
3. <https://metacyc.org>
4. <https://www.medicalnewstoday.com>
5. <https://journals.indexcopernicus.com>

### Mapping with Programme Outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | M   |     |     |     |     |     |     |     |     |      |      |
| CO2 | M   |     |     |     |     |     |     |     |     |      |      |
| CO3 |     |     |     | S   | S   | S   |     |     |     |      |      |
| CO4 |     |     |     | S   | S   | S   |     |     |     |      |      |
| CO5 |     |     |     |     | S   | S   |     |     | S   |      |      |

**Non-Major Elective 1 - SOCIAL AND PREVENTIVE MEDICINE**

|                                                         |                                                |
|---------------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U1R3MBSEC1                          | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill enhancement Course SEC - 1 (NME) | <b>Hrs/Week:</b> 2, <b>Total Inst. Hrs:</b> 30 |
| <b>Nature of the Course:</b> Skill Development          | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

**Course Objectives**

1. Describe the concepts of health and disease and their social determinants
2. Summarize the health management system
3. Know about the various health care services
4. Outline the goals of preventive medicine
5. Gain knowledge about alternate medicine

**Unit: Introduction to social medicine:****6 hrs**

History of social medicine-concepts of health and disease-social determinants of health and disease-Health and quality of life-Health information system- measures of population health-health policies.

**Unit II: Health management:****6 hrs**

Applications of behavioral sciences and psychology in health management- nutritional programs for health management-water and sanitation in human health-national programs for communicable and non-communicable diseases- environmental and occupational hazards and their control.

**Unit III: Preventive medicine:****6 hrs**

Introduction- role of preventive medicine- levels of prevention-Risk assessment in communities and vulnerable population –surveillance, monitoring and reporting of disease outbreaks - forecasting and control measures in community setting – early detection methods.

**Unit IV: Prevention through alternate medicine:****6 hrs**

Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic outbreaks. International health regulations.

**Unit V:****6 hrs**

Infectious disease outbreak case studies and precautionary response during SARS and MERS coronavirus, Ebola and novel SARS-COV2 outbreaks.

| <b>Course Outcomes</b> |                                                               |                            |
|------------------------|---------------------------------------------------------------|----------------------------|
| <b>CO</b>              | On completion of this course, students will;                  |                            |
| CO1                    | Identify the health information system                        | PO1,PO5, PO6               |
| CO2                    | Associate various factors with health management system       | PO1,PO2, PO3,PO5, PO6, PO9 |
| CO3                    | Choose the appropriate health care services                   | PO1,PO5, PO6               |
| CO4                    | Appraise the role of preventive medicine in community setting | PO4,PO5, PO6               |
| CO5                    | Recommend the usage of alternate medicine during outbreaks    | PO1,PO5, PO6               |

### Text Books

1. Park. K (2021). Textbook of preventive and social medicine, 26th edition. Banarsidas Bhanot publishers.
2. Mahajan& Gupta (2013). Text book of preventive and social medicine, 4th edition. Jaypee brothers medical publishers.
3. Chun-Su Yuan, Eric J. Bieber, Brent Bauer (2006). Textbook of Complementary and Alternative Medicine. Second Edition. Routledge publishers.
4. Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatistics. 12th edition, Jaypee Brothers Medical Publishers.
5. LalAdarshPankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.

### References Books

1. Howard Waitzkin, Alina Pérez, Matt Anderson (2021). Social Medicine and the coming Transformation. First Edition. Routledge publishers.
2. GN Prabhakara (2010). Short Textbook of Preventive and Social Medicine. Second Edition. Jaypee publishers.
3. Jerry M. Suls, Karina W. Davidson, Robert M. Kaplan (2010). Handbook of Health Psychology and Behavioral Medicine. Guilford Press.
4. Marie Eloïse Muller, Marie Muller, MarthieBezuidenhout, KarienJooste (2006). Health Care Service Management. Juta and Company Ltd.
5. Geoffrey Rose (2008). Rose's Strategy of Preventive Medicine: The Complete. OUP Oxford.

### Web Resources

1. <https://www.omicsonline.org/scholarly/social--preventive-medicine-journals-articles-ppts-list.php>
2. [https://www.teacheron.com/online-md\\_preventive\\_and\\_social\\_medicine-tutors](https://www.teacheron.com/online-md_preventive_and_social_medicine-tutors)
3. <https://www.futurelearn.com>
4. <https://www.healthcare-management-degree.net>
5. <https://www.conestogac.on.health-care-administration-and-service-management>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | S   |     |     |     | S   | S   |     |     |     |      |      |
| CO2 | S   | S   |     | M   | S   | S   |     |     | M   |      |      |
| CO3 |     |     |     | M   | S   | S   |     |     |     |      |      |
| CO4 | S   |     |     | S   | S   | M   |     |     |     |      |      |
| CO5 | S   |     |     |     | S   | S   |     |     |     |      |      |

## BRIDGE MICROBIOLOGY

|                                                |                                               |
|------------------------------------------------|-----------------------------------------------|
| <b>Course Code:</b> U1R3MBFC                   | <b>Credit:</b> 2                              |
| <b>Category:</b> Foundation Course             | <b>Hrs/Week:</b> 2, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ EXT: 75 = 100          |

### Course Objectives:

1. Learn the introduction and scope of Microbiology
2. Describe the Microbial Taxonomy.
3. Explain the measurement of growth.
4. Understand the Cell Biology
5. Learn the basic instruments

### Unit I:

6 hrs

Introduction and Scope of Microbiology, Microorganisms – Types, Structure and Function.

### Unit II:

6 hrs

Microbial Taxonomy – Nomenclature, Taxonomic ranks, Structural Taxonomy, Numerical Taxonomy, Nucleic acid sequencing.

### Unit III:

6 hrs

Microbial Physiology – Microbial Growth (Batch, Continuous, Synchronous), Growth Curve, Nutrient requirements

### Unit IV:

6 hrs

Cell Biology – Cell as basic unit: Discovery of cells, Classification of cell types, Mechanism of Cell division – Mitosis & Meiosis.

### Unit V:

6 hrs

Basic Instruments – pH meter, Centrifuge – Preparative, Analytical and Ultra, Laminar Air Flow Chamber, Autoclave, Hot Air Oven and Incubator.

### Course Outcomes:

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

- Understand the introduction and scope of Microbiology
- Get knowledge on Microbial Taxonomy.
- Explain the measurement of growth.
- Understand the Cell Biology
- Learn the basic instruments

### Text Books

1. Pelczar.M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7thEdition.,McGraw –Hill, New York.
2. Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition.
3. Tortora, G.J., Funke, B.R., Case,C.L. (2013). Microbiology. An Introduction 11thEdition., A La Carte Pearson.

### Reference Books

1. Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9thEdition). Jones & Bartlett learning 2010.
2. Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5thEdition., MacMillan Press Ltd

### Web Resources

1. <https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>
2. <https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/#>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     |     | M   | M   |     |     |     | M    |      |
| CO2 |     |     |     |     |     |     |     |     |     | M    | M    |
| CO3 |     |     |     |     |     |     |     |     |     |      | S    |
| CO4 |     |     |     | M   |     |     |     |     |     |      | S    |
| CO5 |     |     |     | M   |     |     |     |     |     |      | S    |

## Semester II

### MICROBIAL PHYSIOLOGY AND METABOLISM

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U2R3MBCC3                  | <b>Credit:</b> 5                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 5, <b>Total Inst. Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

#### Course Objectives

1. Study the basic principles of microbial growth.
2. Learn the Nutrition transport mechanism.
3. Understand the basic concepts of aerobic and anaerobic metabolic pathways.
4. Provide information on sources of energy and its utilization by microorganisms.
5. Study the different types of bacterial reproduction.

#### Unit I:

15 hrs

Physiology of microbial growth: Batch – continuous - synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Factors influencing the microbial growth.

#### Unit II:

15 hrs

Nutrition requirements - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms – Simple, Passive facilitated diffusion , Active transport and Group Location.

#### Unit III:

15 hrs

An overview of Metabolism - Embden Meyerhof Pathway, Entner-Doudoroff Pathway, Pentose Phosphate Pathway, Tricarboxylic Acid Cycle. Electron Transport Chain and Oxidative Phosphorylation. ATP synthesis. Fermentation-Homolactic Fermentation, Heterolactic Fermentation, Mixed Acid Fermentation, Butanediol Fermentation.

#### Unit IV:

15 hrs

**Photosynthesis** - An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction- Cyclic and non-cyclic Photophosphorylation. Dark Reaction - Calvin Cycle. **Bacterial Enzymes.**

**Unit V:**

**15 hrs**

**Bacterial reproduction** - Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. **Fungi asexual and sexual reproduction, Microalgae reproduction.** Asexual and sexual **reproduction of protozoa.**

| Course Outcomes |                                                                 |               |
|-----------------|-----------------------------------------------------------------|---------------|
| Course Outcomes | On completion of this course, students will                     |               |
| CO1             | Describe the factors influencing the growth of microorganisms . | PO6, PO9      |
| CO2             | Know nutrition requirements and nutrition transport.            | PO6, PO7, PO9 |
| CO3             | Describe anaerobic and aerobic energy metabolic pathways.       | PO6, PO9      |
| CO4             | Explain the methods of nutrient uptake.                         | PO6, PO9      |
| CO5             | Elaborate on the process of bacterial reproduction.             | PO6, PO9      |

**Text Books**

1. Schlegel, H.G. (1993). General Microbiology.,7th Edition, Press syndicate of the University of Cambridge.
2. RajapandianK.(2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3. MeenaKumari. S. Microbial Physiology, Chennai 1st Edition MJP Publishers 2006.
4. Dubey R.C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
5. S. Ram Reddy, S.M. Reddy (2008). Microbial Physiology. Anmol Publications Pvt Ltd.

**Reference Books**

1. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
2. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
3. Daniel R. Caldwell. (1995). Microbial Physiology & Metabolism Wm.C. Brown Communications, Inc. USA.
4. Moat, A.G and J.W Foaster (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.

5. BhanuShrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.

### Web Resources

1. <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
2. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
3. [https://onlinecourses.swayam2.ac.in/cec20\\_bt14/preview](https://onlinecourses.swayam2.ac.in/cec20_bt14/preview)
4. [http://web.iitd.ac.in/~amittal/2007\\_Addy\\_Enzymes\\_Chapter.pdf](http://web.iitd.ac.in/~amittal/2007_Addy_Enzymes_Chapter.pdf)
5. <https://www.frontiersin.org/microbial-physiology-and-metabolism>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     |     |     | M   |     |     | M   |      |      |
| CO2 |     |     |     |     |     | M   | L   |     | M   |      |      |
| CO3 |     |     |     |     |     | M   |     |     | M   |      |      |
| CO4 |     |     |     |     |     | M   |     |     | M   |      |      |
| CO5 |     |     |     |     |     | M   |     |     | M   |      |      |

## PRACTICAL II - MICROBIAL PHYSIOLOGY AND METABOLISM

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| <b>Course Code:</b> U2R3MBCC4P                 | <b>Credit:</b> 5                     |
| <b>Category:</b> Core Course – Practical II    | <b>Hrs/Week:</b> 5                   |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40+ EXT: 60 = 100 |

### Course Objectives

1. To Understand the growth requirements
2. To know the parameters for growth and bacterial characteristics
3. To aid identification of microorganisms by various biochemical test
4. To become familiar with biochemical test
5. To isolate microorganisms from the environment

1. Measurement of bacterial growth- Total Cell Count, Viable Cell Count & turbidity.
2. Effect of environmental factors on bacterial growth – pH, temperature
3. IMVIC – Test
  - (i) Indole
  - (ii) Methyl Red
  - (iii) Voges – Proskauer
  - (iv) Citrate Utilization
4. Carbohydrate fermentation
5. Mixed acid fermentation
6. Butanediol fermentation
7. Oxidase test
8. Catalase test
9. Nitrate reduction test
10. Starch hydrolysis
11. Casein hydrolysis
12. Urea hydrolysis
13. Gelatin liquefaction
14. H<sub>2</sub>S production

| <b>Course Outcomes</b> |                                                                                                    |                          |
|------------------------|----------------------------------------------------------------------------------------------------|--------------------------|
| <b>Course Outcomes</b> | On completion of this course, students will;                                                       |                          |
| CO1                    | Describe hanging drop, wet mount preparation, semi-solid agar, Craigie's tube method.              | PO6, PO7, PO8, PO9, PO11 |
| CO2                    | Demonstrate Smear preparation, permanent specimen preparation, Capsular, and Acid-fast staining.   | PO6, PO7, PO8, PO9, PO11 |
| CO3                    | Explain antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains. | PO6, PO7, PO8, PO9, PO11 |
| CO4                    | Describe demonstration of the size of yeast, fungal filaments and protozoa.                        | PO6, PO7, PO8, PO9, PO11 |
| CO5                    | Elaborate on the bacterial identification- morphological, physiological, and biochemical methods.  | PO6, PO7, PO8, PO9, PO11 |

### **Text Books**

1. James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York .
2. Kannan. N (1996).Laboratory manual in General Microbiology. Palani Publications.
3. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
4. Gunasekaran. P (2007). Laboratory manual in Microbiology. New age international publisher.
5. Elsa Cooper (2018). Microbial Physiology: A Practical Approach. Callisto Reference publisher.

### **Reference Books**

1. DavidWhite., James Drummond., Clay Fuqua (2012) Physiology and Biochemistry of Prokaryotes. 4th Ed. Oxford University Press, New York.
2. Robert K. Poole (2004). Advances in Microbial Physiology, Elsevier Academic Press, New York, Volume 49.
3. Kim B.H., Gadd G.M. (2008). Bacterial Physiology and Metabolism. Cambridge University Press, Cambridge.
4. Dawes, I.W and Sutherland L.W (1992). Microbial Physiology (2nd edition), Oxford Blackwell Scientific Publications.
5. Moat, A.G and J.W Foaster, (1995). Microbial Physiology, 3rd edition. Wiley – LISS, A John Wiley & Sons. Inc. Publications.

### Web Resources

1. <https://sites.google.com/site/microbialphysiologyoddsem/teaching-contents>
2. <https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-Nutrition>
3. [https://onlinecourses.swayam2.ac.in/cec20\\_bt14/preview](https://onlinecourses.swayam2.ac.in/cec20_bt14/preview)
4. <https://www.studocu.com/microbial-physiology-practicals>
5. <https://www.agr.hokudai.ac.jp/microbial-physiology>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     |     |     | M   | L   | M   | L   |      | M    |
| CO2 |     |     |     |     |     | M   | M   | L   | M   |      | L    |
| CO3 |     |     |     |     |     | L   | M   | M   | L   |      | M    |
| CO4 |     |     |     |     |     | L   | M   | M   | M   |      | M    |
| CO5 |     |     |     |     |     | M   | M   | M   | M   |      | M    |

## BIOINSTRUMENTATION

|                                                  |                                                |
|--------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U2R3MBDSE2:1                 | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective II | <b>Hrs/Week:</b> 4, <b>Total Inst. Hrs:</b> 60 |
| <b>Nature of the Course:</b> Employability       | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

### Course Objectives

1. Understand the analytical instruments and study the basic principles in the field of sciences.
2. To gain knowledge about principles of spectroscopy
3. Understand the analytical techniques of Chromatography and electrophoresis
4. To understand the principle of different types of scans used in medical diagnosis
5. To gain information about the principles of radioactivity and its measurements

### Unit I:

12 hrs

Acids, bases, buffers; measurements- units of weights and volume; Preparation of solutions; calculation of concentration and methods of expressing concentration of solutions- normality and molarity solutions. Basic instruments- balances, pH meter, Laminar air flow chamber.

### Unit II:

12 hrs

Preparative and Analytical Centrifuges, Sedimentation analysis RCF, Density Gradient Centrifugation. Colorimetry – principle, Beer – Lambert's law – Applications.

### Unit III:

12 hrs

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, MS, NMR, ESR, Atomic Absorption Spectroscopy, Electrophoretic Techniques: Theory and Application of PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing,.

### Unit IV:

12 hrs

Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC, HPLC.

**Unit V:****12 hrs**

**Introduction to Radioisotopes and their Biological Applications,** Radioactive Decay. Types and Measurement, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, Radiation Dosimetry.

| <b>Course Outcomes</b> |                                                                                         |               |
|------------------------|-----------------------------------------------------------------------------------------|---------------|
| <b>Course Outcomes</b> | On completion of this course, students will;                                            |               |
| CO1                    | Gain knowledge about the basics of instrumentation.                                     | PO1,PO4,PO11  |
| CO2                    | Exemplify the structure of atoms and molecules by using the principles of spectroscopy. | PO4,PO10,PO11 |
| CO3                    | Evaluate by separating and purifying the components.                                    | PO4,PO7,PO11  |
| CO4                    | Understand the need and applications of imaging techniques.                             | PO7,PO8,PO11  |
| CO5                    | Categorize the working principle and applications of fluorescence and radiation.        | PO10,PO11     |

**Text Books**

1. Nayaraman J (2011). Laboratory Manual in Biochemistry, 2nd Edition. Wiley Eastern Ltd., New Delhi .
2. Ponmurugan. P and Gangathara PB (2012). Biotechniques.1stEdition. MJP publishers.
3. Veerakumari, L (2009).Bioinstrumentation- 5 thEdition -.MJP publishers.
4. Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry – Principles and techniques 3rd Edition. Himalaya publishing home.
5. Chatwal G and Anand (1989). Instrumental Methods of Chemical Analysis. S.Himalaya Publishing House, Mumbai.

**Reference Books**

1. Rodney.F.Boyer (2000). Modern Experimental Biochemistry, 3rd Edition. Pearson Publication.
2. SkoogA.,WestM (2014). Principles of Instrumental Analysis – 14th Edition W.B.SaundersCo.,Philadephia.
3. N.Gurumani. (2006). Research Methodology for biological sciences- 1st Edition – MJP

Publishers .

4. Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition. Cambridge University Press .

5. Webster, J.G. (2004). Bioinstrumentation- 4th Edition - John Wiley & Sons (Asia) Pvt.Ltd, Singapore.

### Web Resources

1. <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types-uses-and-other-details-with-diagram/12489>
2. <https://www.watelectrical.com/biosensors-types-its-working-andapplications/>
3. <http://www.wikiscales.com/articles/electronic-analytical-balance/> Page 24 of 75
4. <https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html>
5. <http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | L   |     |     | M   |     |     |     |     |     |      | S    |
| CO2 |     |     |     | L   |     |     |     |     |     | M    | S    |
| CO3 |     |     |     | L   |     |     | M   |     |     |      | S    |
| CO4 |     |     |     |     |     |     | S   | S   |     |      | S    |
| CO5 |     |     |     |     |     |     |     |     |     | M    | S    |

## NUTRITION & HEALTH HYGIENE

|                                                        |                                                |
|--------------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U2R3MBSEC2                         | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course -SEC-2 (NME) | <b>Hrs/Week:</b> 2, <b>Total Inst. Hrs:</b> 30 |
| <b>Nature of the Course:</b> Skill Development         | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

### Course Objectives

1. Learn about nutrition and their importance
2. Make student understand the nutritional facts for a better life.
3. Learn information to optimize our diet
4. Impart knowledge on different health care programs taken up by India
5. Learn knowledge on different health indicators and types of hygiene methods

### Unit I:

6 hrs

**Nutrition** – definition, importance, Good nutrition, and mal nutrition; Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins –functions, dietary sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; **food sources** of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. **Importance of water**– functions, sources, requirements and effects of deficiency.

### Unit II:

6 hrs

**Nutrition for Life Cycle: Balanced diet** - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; **Nutritive value of Indian foods.**

### Unit III:

6 hrs

**Improper diets:** Definition, Identification, Signs and Symptoms - malnutrition, under-nutrition, over-nutrition, Protein Energy Malnutrition, obesity; **Nutritional Disease and Disorder** - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease.

### Unit IV:

6 hrs

**Health-Education: Principles and Strategies.** Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.

**Unit V:****6 hrs**

**Hygiene** – Definition; Personal, Community, Medical and **Culinary hygiene**; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee.

**Course Outcomes**

| <b>Course Outcomes</b> | On completion of this course, students will;                             |                          |
|------------------------|--------------------------------------------------------------------------|--------------------------|
| CO1                    | Learn the importance of nutrition for a healthy life                     | PO5, PO6, PO7, PO8, PO10 |
| CO2                    | Study the nutrition for life cycle                                       | PO5, PO6, PO7, PO8, PO10 |
| CO3                    | Know the health care programmes of India                                 | PO5, PO6, PO7, PO8, PO10 |
| CO4                    | Learn the importance of community and personal health & hygiene measures | PO5, PO6, PO7, PO10      |
| CO5                    | Create awareness on community health and hygiene                         | PO5, PO6, PO7, PO10      |

**Text Books**

1. Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition (3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Swaminathan (1995) Food & Nutrition (Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., Bangalore
3. SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
4. Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception and Practices. Satish Serial Publishing House
5. Dass (2021). Public Health and Hygiene, Notion Press

**References Books**

1. Vijaya Khader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2. Srilakshmi, B., (2010) Food Science, (5th Edition) New Age International Ltd., New Delhi
3. Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene, ABD Publishers
4. Sharma D. (2015). Textbook on Food Science and Human Nutrition. Daya Publishing House.

5. Revilla M. K. F., Titchenal A. and Draper J. (2020). Human Nutrition.  
University of Hawaii, Mānoa.

### Web Resources

1. National Rural Health Scheme:  
<https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=969&lid=49>
2. National Urban Health Scheme:  
<https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=970&lid=137>
3. Village health sanitation & Nutritional committee  
<https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=149&lid=225>
4. Health Impact Assessment - <https://www.who.int/hia/about/faq/en/>
5. Healthy Living <https://www.nhp.gov.in/healthylivingViewall>

### Mapping with Programme Outcomes

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 |     |     |     |     | S   | M   | M   | M   |     | S    |      |
| CO2 |     |     |     |     | S   | M   | M   | M   |     | S    |      |
| CO3 |     |     |     |     | S   | M   | M   | M   |     | S    |      |
| CO4 |     |     |     |     | S   | S   | L   |     |     | S    |      |
| CO5 |     |     |     |     | S   | S   | M   |     |     | S    |      |

## SERICULTURE

|                                                  |                                                |
|--------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U2R3MBSEC3:1                 | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course -SEC-3 | <b>Hrs/Week:</b> 2, <b>Total Inst. Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship    | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

### Course Objectives

1. Acquire knowledge on the concepts of origin, growth and study of Sericulture as science and scientific approach of mulberry plant.
2. Describe the morphology and physiology of silkworm.
3. Discuss effective management of silkworm diseases.
4. Demonstrate field skills in mulberry cultivation and silkworm rearing with an emphasis on technological aspects.
5. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.

### Unit I:

6 hrs

General introduction to Sericulture, its distribution in India. Botanical distribution and taxonomical characters of mulberry varieties and species. Biology of Mulberry plant and Mulberry crop cultivation and protection.

### Unit II:

6 hrs

Silkworm- biology-morphology of silkworm. Life cycle of silkworm- egg, larva, pupa, and moth.

### Unit III:

6 hrs

Silkworm pathology: Introduction to Parasitism, Commensalism, Symbiosis and Parasite relationship - Mulberry Silkworm Diseases: Introduction, types, Pebrine, Grasserie, Muscardine, Flacherie, Symptoms and Pathogens, Mode of Infection, Prevention and Control -Non – mulberry silkworm diseases: Pebrine, Bacterial and viral diseases. Brief Account of Pests and Predators of Silkworms, Nature of damage and control measures.

**Unit IV:****6 hrs**

**Rearing of silkworm.** Cocoon assessment and processing technologies. Value added products of mulberry and silkworms.

**Unit V:****6 hrs**

**Entrepreneurship and rural development in sericulture:** Planning for EDP, Project formulation, Marketing, Insectary facilities and equipments: Location, building specification, air conditioning and environmental control, furnishings and equipment, sanitation and equipment, subsidiary facilities.

| <b>Course Outcomes</b> |                                                                                                                                                                                                                                                        |                |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Course Outcomes</b> | On completion of this course, students will;                                                                                                                                                                                                           |                |
| CO1                    | Discuss the overall aspects of Sericulture and the biology and varieties of mulberry plant. Creates awareness among students about the economic importance and suitability of Sericulture in Indian conditions.                                        | PO1, PO5, PO7  |
| CO2                    | Familiarize with the lifecycle of silk worm.                                                                                                                                                                                                           | PO1, PO2       |
| CO3                    | Explain common diseases of silkworm encountered during rearing, sources of infection, disease symptoms, pre-disposing factors and their management practices.                                                                                          | PO1, PO5       |
| CO4                    | Attain thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing, post cocoon techniques like stifling, reeling, and utilization of by-products.                                                | PO7, PO8, PO10 |
| CO5                    | Plan the facilities required for establishment of insectary. Competent to transfer the knowledge and technical skills to the Seri-farmers. Analyze the importance of sericulture in entrepreneurship development and emerge as potential entrepreneur. | PO5, PO7, PO8  |

**Text Books**

1. Ganga, G. and SulochanaChetty(2010). Introduction to Sericulture,, J., Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
2. Dr. R. K. Rajan&Dr. M. T. Himantharaj(2005). Silkworm Rearing Technology, Central Silk Board, Bangalore.

3. Dandin S B, JayantJayaswal and Giridhar K (2010). Handbook of Sericulture technologies, Central Silk Board, Bangalore.
4. M. C. Devaiah, K. C. Narayanaswamy and V. G. Maribashetty(2010). Advances in Mulberry Sericulture,,CVG Publications, Bangalore
5. T.V.SatheandJadhav.A.D.(2021). Sericulture and Pest Management, Daya Publishing House.

### Reference Books

1. S. Morohoshi (2001). Development Physiology of Silkworms 2ndEdition, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
2. Hamamura, Y (2001). Silkworm rearing on Artificial Diet. Oxford & IBH publishing Co., Pvt. Ltd. NewDelhi.
3. M.Johnson, M.Kesary (2019).Sericulture, 5th.Edition.Saras Publications.
4. Manisha Bhattacharyya (2019).Economics of Sericulture, Rajesh Publications.
5. Muzafar Ahmad Bhat, SurakshaChanotra, ZafarIqbalBuhroo, Abdul Aziz and Mohd.Azam (2020).A Textbook on Entrepreneurship Development Programme in Sericulture, IP Innovative Publication.

### Web Resources

1. <https://egyankosh.ac.in> › bitstream
2. <https://archive.org> › details › SericultureHandbook
3. <https://www.academic.oup.com>
4. <https://www.sericulture.karnataka.gov.in>
5. <https://www.silks.csb.gov.in>

### Mapping with Programme Outcomes:

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | S   |     |     |     | S   |     | S   |     |     |      |      |
| CO2 | M   |     |     |     | S   |     |     |     |     |      |      |
| CO3 | S   |     |     |     | S   |     |     |     |     |      |      |
| CO4 |     |     |     |     |     |     | S   | S   |     | S    |      |
| CO5 |     |     |     |     | S   |     | S   | S   |     |      |      |

## VETERINARY MICROBIOLOGY

|                                                  |                                                |
|--------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U2R3MBSEC3:2                 | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course -SEC-3 | <b>Hrs/Week:</b> 2, <b>Total Inst. Hrs:</b> 30 |
| <b>Nature of the Course:</b> Employability       | <b>Marks:</b> CIA: 25+ EXT: 75 = 100           |

### Course Objectives:

1. To learn about spore forming bacteria and some important aerobes and anaerobes.
2. To learn general and pathogenic mycology.
3. To study viral properties, epidemiology, pathogenesis
4. To understand science and practice of vaccines
5. To provide training in essential diagnostic techniques.

### Unit I

6 hrs

**Systematic study of following pathogenic bacteria:** Gram positive cocci, family Micrococaceae, endospore forming Gram positive rods and cocci, family Bacillaceae genus Bacillus, Sporolactobacillus and Clostridium. Spirochetes. Family Spirochetaceae and other families like Spirillaceae, coryneform bacteria, Dermatophilaceae, Streptomyetaceae.

### Unit II

6 hrs

**Systematic study of animal mycoses** such as Aspergillosis, Candidiasis, Cryptococcosis, Epizootic Lymphangitis, Mycetomas, Sporotrichosis, Histoplasmosis, Blastomycosis, Coccidioidomycosis, Haplomycosis, Rhinosporidiosis, Zygomycosis, Mycotic Abortion, Mycotic Mastitis, Mycotic Dermatitis, Dermatophytoses, Mycotoxicosis etc.

### Unit III

6 hrs

**New castle disease virus,** canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

### Unit IV

6 hrs

**History of veterinary vaccinology.** Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes.

## Unit V

6 hrs

**Diagnosis of infectious diseases: an overview.** Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

| Course Outcomes |                                                                        |                |
|-----------------|------------------------------------------------------------------------|----------------|
| Course Outcomes | On completion of this course, students will;                           |                |
| CO1             | Explain bacterial pathogenic microorganisms of veterinary significance | PO1,PO5,PO7    |
| CO2             | Identify the zoonotic aspects of microbial pathogens                   | PO1, PO2       |
| CO3             | Examine the viral diseases associated with animals                     | PO1, PO5       |
| CO4             | Justify the clinical specimens of infectious diseases.                 | PO7, PO8, PO10 |
| CO5             | Elaborate the veterinary vaccines                                      | PO5, PO7, PO8  |

### Text Books:

1. Glen Sonder J & Karen W Post 2005. Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases. Cold Spring Harbor Lab. Press.
2. Prescott LM, Harley JP & Klen DA. 2005. Microbiology. Wm. C. Brown Publ.
3. Tortora GJ, Funke BR & Case CL. 2004. Microbiology: An Introduction. Benjamin/Cummins Publ.
4. Carter J & Saunders V. 2007. Virology: Principles and Applications. 1st Ed. Wiley.
5. Knipe DM, Howley PM, Griffin DE. 2006. Fields Virology. 5th Ed. Vols. I, II. Lippincott, Williams & Wilkins.

### Reference Books:

1. Dodds WJ & Schulz R. (Eds). 1999. Veterinary Vaccines and Diagnostics. Vol. 41 (Advances in Veterinary Medicine) 1st Ed. Academic Press.
2. Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. New Generation Vaccines. 3rd Ed. Marcel-Dekker.

3. Pastoret PP, Blancou J, Vannier C &Verschueren C. 1997. Veterinary Vaccinology. Elsevier.
4. Detrick B & Hamilton RG. (Eds). 2006. Manual of Molecular and Clinical Laboratory Immunology. 7th Ed. American Society for Microbiology.
5. Rose NR, Friedman H & Fahey JL. (Eds). 1986. Manual of Clinical Laboratory Immunology. American Society for Microbiology.
6. Weir DM. 1986. Handbook of Experimental Immunology. Vol. IV. Blackwell.

#### **Web Resources**

1. <https://www.us.elsevierhealth.com/veterinary-microbiology-0378-1135.html>
2. <https://www.journals.elsevier.com/veterinary-microbiology/most-downloaded-articles>
3. <https://wcvm.usask.ca/departments/vet-micro.php>

#### **Mapping with Programme Outcomes:**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| CO1 | S   |     |     |     | S   |     | S   |     |     |      |      |
| CO2 | M   |     |     |     | S   |     |     |     |     |      |      |
| CO3 | S   |     |     |     | S   |     |     |     |     |      |      |
| CO4 |     |     |     |     |     |     | S   | S   |     | S    |      |
| CO5 |     |     |     |     | S   |     | S   | S   |     |      |      |

## IMMUNOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U3R3MBCC5                  | <b>Credit:</b> 5                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To acquire with basic knowledge in immunology
- ❖ To familiarize with the immunity and immune system
- ❖ To understand the antigen antibody reactions
- ❖ To study the various allergic reactions
- ❖ To get knowledge on transplantation

### Unit – I History of Immunology

15 hrs

Introduction: – History of Immunology – Immunoematology, Blood groups – ABO and Rh typing, Blood transfusion – Rh – incompatibility – Immunity – types of immunity – Innate – Anatomical, physiological, phagocytic and inflammatory barriers, Acquired – cell mediated and humoral immunity. Hematopoiesis.

### Unit – II Immune System

15hrs

Cells and organs of Immune system – Lymphocytes - T Cells, B Cells, Macrophages, Granulocytic cells – Neutrophils, Eosinophils, Basophils, Mast cells, Dendritic cells, and NK cells. Primary lymphoid organs- Thymus and Bone marrow; Secondary lymphoid organs – Lymphnodes, Spleen, MALT, CALT and GALT.

### Unit – III Antigen and Antibody Molecules

15hrs

**Antigen:** Types, properties, immunogen, epitope, paratope, haptens and adjuvants. Vaccines – types - whole organisms vaccine, purified macromolecule vaccine, recombinant vaccine, anti-idiotypic vaccine and DNA vaccine – toxoids, antitoxins. Immunization Schedule. **Antibody** – structure, types and properties. Monoclonal Antibodies. Complement pathway- classical and alternate.

### Unit – IV Antigen – Antibody Reactions

15hrs

**In vitro methods:** Agglutination – Widal test, Haemagglutination, HAI - Precipitation – Immunodiffusion and Immunoelectrophoresis, Complement fixation, Immunofluorescence, Enzyme linked immunosorbent assay (ELISA), Radio-immuno assay (RIA) and Fluorescent *In situ* Hybridization (FISH).

IgE mediated - Type I Hypersensitivity, Antibody – mediated Type II Hypersensitivity, Immune complex mediated Type III Hypersensitivity and Type IV – Delayed type Hypersensitivity. Cytokines, MHC and Transplantation.

**Text Books:**

1. Ivan M. Roitt, Jonathan Brostoff, David K. Male, 1998, Immunology, 4<sup>th</sup> Edition, Mosby Press, New York.
2. Janni Putt, Sharon Stranford, Patricia Jones, Judith A Owen, 2018, Kuby Immunology, 8<sup>th</sup> Edition, WH Freeman and Company, New York.
3. Shastri N.V, 2009, Principles of Immunology, 5<sup>th</sup> Edition, Himalaya Publishing House, Mumbai.
4. Rastogi S.C, 2008, Elements of Immunology, CBS Publishers, New Delhi.
5. Ajoy Paul, 2016, Text Book of Immunology, Books and Allied (P) Ltd. Kolkata
6. Dulsy Fatima, Arumugam N, 2017, Immunology, Saras Publication, Tamilnadu
7. Fathimunisa Begum, 2014, Immunology, PHI Learning Pvt. Ltd. Haryana
8. Kannan I, 2015, Immunology, MJP Publishers, Chennai
- 9.

**Reference Books:**

1. Peter Lydyard, Alex Whelan, Michael Fanger, 2011, BOIS Instant notes in Immunology, 3<sup>rd</sup> Edition, CRC Press, London.
2. David Male, Jonathan Brostoff, David B Roth, Ivan Roitt, 2007, 7<sup>th</sup> Edition, Mosby Press, New York.
3. Janis Kuby, Thomas J. Kindt, Richard Goldsby, Barbara A. Osborne, 2000, Kuby Immunology, 4<sup>th</sup> Edition, W.H. Freeman and Company, New York.
4. Abul K. Abbas, Andrew H. Lichtman, Jordan S. Pober, 1997, Cellular and Molecular Immunology, 3<sup>rd</sup> Edition, W.B. Saunders Company, New York
5. Ian R.Tizard, 2004, Veterinary Immunology: An Introduction, 7<sup>th</sup> Edition, W B Saunders Co Ltd . USA.
6. Joshi K.R. and Osama N.O, 2005, Immunology and Serology, Student Edition, Agrobios (India)

**Course Outcomes:**

After the completion of this Course work students will be able to

| S.No. | Course Outcomes                                   | Knowledge Level |
|-------|---------------------------------------------------|-----------------|
| CO1   | Define immunity and blood grouping                | K1              |
| CO2   | Differentiate various lymphoid organs             | K4              |
| CO3   | Acquire Knowledge on antigen and antibody         | K5              |
| CO4   | Perform antigen antibody reactions <i>invitro</i> | K3              |
| CO5   | Elaborate allergic reactions and transplantation  | K6              |

| Title of the Course:Immunology |                          |      |      |      |      | Course Code:U3R3MBCC5              |       |       |       |       |                   |
|--------------------------------|--------------------------|------|------|------|------|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)          | Programme Outcomes (POs) |      |      |      |      | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                | PO 1                     | PO 2 | PO 3 | PO 4 | PO 5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                            | 3                        | 3    | 3    | 3    | 3    | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO2                            | 3                        | 3    | 3    | 3    | 3    | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO3                            | 3                        | 3    | 3    | 3    | 3    | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO4                            | 3                        | 3    | 3    | 3    | 3    | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO5                            | 3                        | 3    | 3    | 3    | 3    | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
|                                | Mean Overall Score       |      |      |      |      |                                    |       |       |       |       | 2.82              |
|                                | Result                   |      |      |      |      |                                    |       |       |       |       | High              |

**PRACTICAL – III – (Covering – CC5 – IMMUNOLOGY)**

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| <b>Course Code:</b> U3R3MBCC6P                 | <b>Credit:</b> 5                     |
| <b>Category:</b> Core Practical                | <b>Hrs/Week:</b> 05                  |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40+ Ext: 60 = 100 |

**Course Objectives:**

- ❖ To know the blood grouping
- ❖ To be familiar in identifying typhoid
- ❖ To have knowledge on blood cell count
- ❖ To demonstrate the ELISA
- ❖ To measure the c-reactive Protein

1. ABO blood grouping
2. Rh Typing
3. WIDAL test (Slide and Tube Agglutination Test)
4. RPR - Rapid Plasma Reagin Test
5. CRP – C-Reactive Protein Test
6. ASO - Anti-Streptolysin O test
7. Total Blood cell count by Haemocytometer
8. Differential WBC count
9. Single Radio Immunoassay
10. Double Immunodiffusion
11. Demonstration of ELISA
12. Demonstration of Immunoelectrophoresis

**References:**

1. Aneja K.R. (2010). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.
3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams & Wilkin Publishers.
4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

**Course Outcomes:**

After the completion of this Course work students will be able to

| S.No. | Course Outcomes                                | Knowledge Level |
|-------|------------------------------------------------|-----------------|
| CO1   | Examine blood grouping                         | K4              |
| CO2   | Analyze the typhoid fever                      | K4              |
| CO3   | Utilize the hemocytometer for blood cell count | K3              |
| CO4   | Demonstrate ELISA                              | K2              |
| CO5   | Determine the level of C-reactive protein      | K5              |

| Title of the Course: Major Practical – III |                          |     |     |     |     | Course Code: U3R3MBCC6P            |     |     |     |     |                   |
|--------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-----|-----|-----|-----|-------------------|
| Course Outcomes (COs)                      | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |     |     |     |     | Mean Score of COs |
|                                            | PO1                      | PO2 | PO3 | PO4 | PO5 | PO1                                | PO2 | PO3 | PO4 | PO5 |                   |
| CO1                                        | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO2                                        | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO3                                        | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO4                                        | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO5                                        | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
|                                            | Mean Overall Score       |     |     |     |     |                                    |     |     |     |     | 3.0               |
|                                            | Result                   |     |     |     |     |                                    |     |     |     |     | High              |

## MICROBIAL INOCULANTS

|                                            |                                                |
|--------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U3R3MBSEC4:1           | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course  | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Employability | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To gain information on microbes used as biofertilizers
- ❖ To get acquire knowledge of symbiotic nitrogen fixers
- ❖ To enable knowledge about non-symbiotic nitrogen fixers
- ❖ To know the phosphate solubilizers
- ❖ To familiarize with the knowledge of mycorrhizae.

### Unit I: Introduction

6hrs

General account of the microbes used as biofertilizers for crop plants and their advantages. Biocontrol agent – *Pseudomonas*. Green Manure – *Azolla*.

### Unit II: Symbiotic N<sub>2</sub> fixers

6hrs

*Rhizobium* - Cyanobacteria – *Frankia* – Isolation, identification, characterization, mass inoculum production and applications.

### Unit III: Non - symbiotic N<sub>2</sub> fixers

6hrs

*Azospirillum*- Free living – *Azotobacter*- isolation, characterization, mass inoculums production and field application.

### Unit IV: Phosphate solubilizers

6hrs

Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

### Unit V: Mycorrhizae

6 hrs

Mycorrhizae - classification - Taxonomy of mycorrhizae - Isolation of AM fungi - Mass inoculums production of AM – field application of Ectomycorrhizae and AM.

### Text Books

1. G. Rangaswami, D.J.Bagyaraj, 2004, Agricultural Microbiology, Second Edition, Prentice Hall of India Pvt. Ltd.
2. Dr.Arora Brij Bala Arora, 2020, Text Book of Microbiology, Sixth Edition, CBS Publishers.
3. Subba Rao N.S, 2005, Soil Microbiology, 4<sup>th</sup> Edition, Oxford and IBH Publishing co Pvt. Lid.
4. Mark coyne, 2001, Soil Microbiology, First Edition, Thomson Asia Pvt. Ltd.

5. Dr. S. Rajan, R. Selvi Christy, 2016, Essential of Microbiology, Second Edition, CBS Publishers & Distributors Pvt. Ltd.

### Reference Books

1. Singh, D.P., Singh, H.B. and Prabha, R. eds., 2016, Microbial inoculants in sustainable agricultural productivity, New Delhi: Springer.
2. Singh, D.P., Singh, H.B. and Prabha, R. eds., 2016, Microbial inoculants in sustainable agricultural productivity: vol. 1: research perspectives, Springer India. Dilworth,
3. M.J., James, E.K., Sprent, J.I. and Newton, W.E. eds., 2008, Nitrogen-fixing leguminous symbioses, Springer Science & Business Media.
4. Somani, L., Shilpkar, P. and Shilpkar, D., 2011, Biofertilizers: Commercial Production Technology & Quality Control. Agrotech Pub. Academy.
5. Sundaro Rao, W.V.B. and Sinha, M.K., 1963, Phosphate dissolving micro-organisms in the soil and rhizosphere.

### Course Outcomes

After completion of this course work students would be able to

| S.No | Course outcome                            | Knowledge level |
|------|-------------------------------------------|-----------------|
| CO1  | Describe microbes used as Biofertilizer   | K2              |
| CO2  | Explain symbiotic nitrogen fixers         | K3              |
| CO3  | Select non- symbiotic nitrogen fixers     | K5              |
| CO4  | Interpret phosphate solubilizing microbes | K2              |
| CO5  | Classify mycorrhizae                      | K2              |

| Title of the Course: Microbial Inoculants |                          |     |     |     |     | Course Code: U3R3MBSEC4:1          |       |       |       |       |                   |
|-------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                     | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                           | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                       | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.6               |
| CO2                                       | 3                        | 1   | 1   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.4               |
| CO3                                       | 3                        | 1   | 1   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.4               |
| CO4                                       | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.7               |
| CO5                                       | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.6               |
| Mean Overall Score                        |                          |     |     |     |     |                                    |       |       |       |       | 2.54              |

|  |               |             |
|--|---------------|-------------|
|  | <b>Result</b> | <b>High</b> |
|--|---------------|-------------|

## AQUACULTURE

|                                            |                                                |
|--------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U3R3MBSEC4:2           | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course  | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Employability | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ Provide a deeper knowledge in aquaculture systems and methods.
- ❖ Explain the significance and functions of design, types and construction of aquaculture ponds.
- ❖ Demonstrate the biological characteristics of various aquaculture species.
- ❖ Discuss the methods involved in post stocking management.
- ❖ Illustrate major cultivatable species for aquaculture.

### Unit I

**6 hrs**

**Aquaculture Systems and Methods - Scope and definition.** Traditional, extensive, semi - intensive and intensive culture. Monoculture, polyculture, composite culture, mixed culture, mono-sex culture, cage culture, pen culture, raft culture, race way culture.

### Unit II

**6 hrs**

**Aquaculture Engineering** - Design and construction of pond, lay-out and design of aquaculture farm, construction, water intake system, drainage system - aeration and aerators. Ponds - Types of ponds.

### Unit III

**6 hrs**

**Selection of Species - Biological characteristics of aquaculture species;** economic and market considerations; seed resources, collection and transportation. Pre-Stocking Management-Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes. Stocking - Acclimatization of seed and release - species combinations - stocking density and ratio.

### Unit IV

**6 hrs**

**Post Stocking Management** - Water and soil quality parameters required for optimum production, **control of aquatic weeds** and aquatic insects, algal blooms and microorganisms. Food conversion ratio (FCR). Growth - Measurement of growth, length - weight relationship.

## **Unit V**

**6 hrs**

**Major cultivable species for aquaculture** –Culture of Indian Major Carps. Culture of Giant fresh water prawn, *Macrobrachium rosenbergii* - seed collection formation sources. **Hatchery management.** Culture of tiger shrimp, *Penaeus monodon* and *Litopenaeus vannamei*. Culture of pearl oysters. Culture of sea weeds. Methods of Crab culture. Culture of ornamental fishes. Culture of Molluscs.

## **Text Books**

1. Arumugam N, 2014, Aquaculture, Saras Publication.
2. Tharadevi C.S. Jayashree K.V. Arumugam N, 2015, Home Aquarium and Ornamental Fish Culture. Saras Publication
3. Santhanam R, Sukumaran N, Natarajan P, 1999, Manual of Fresh Water Aquaculture, Oxford & IBH Publishing Co. PVT. LTD
4. Bandyopadhyay, B. K, 2022,. Freshwater Aquaculture: A Functional Approach. United States: Narendra Publishing House.
5. Stickney, R. R. (1994). Principles of aquaculture. United Kingdom: Wiley.

## **Reference Books**

1. John E. Bardach, 1997, Sustainable Aquaculture, Germany: Wiley.
2. Barry A. Costa-Pierce, 2008, Ecological Aquaculture: The Evolution of the Blue Revolution. Germany: Wiley.
3. Nash, C. (2010). The History of Aquaculture. Germany: Wiley.
4. Garth L, Fletcher Matthew L, Rise, 2012, Aquaculture Biotechnology. United Kingdom: Wiley.
5. Boyd, C. E., Tucker, C. (2012). Pond Aquaculture Water Quality Management. United States: Springer US.

## Course Outcomes

After completion of this course work students would be able to

| S.No | Course outcome                                                               | Knowledge level |
|------|------------------------------------------------------------------------------|-----------------|
| CO1  | Analyze the significance and importance of aquaculture                       | K3              |
| CO2  | Illustrate the types and construction of aquaculture ponds                   | K3              |
| CO3  | Analyze the biological characteristics of species                            | K3              |
| CO4  | Follow methods involved for optimal growth of aquaculture species            | K2              |
| CO5  | Summarize major species suitable for aquaculture in a particular environment | K6              |

| Title of the Course: Aquaculture |                          |     |     |     |     | Course Code: U3R3MBSEC4:2          |       |       |       |       |                   |
|----------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)            | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                  | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                              | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.6               |
| CO2                              | 3                        | 1   | 1   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.4               |
| CO3                              | 3                        | 1   | 1   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.4               |
| CO4                              | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.7               |
| CO5                              | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.6               |
|                                  | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.54              |
|                                  | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## MEDICAL MICROBIOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U4R3MBCC7                  | <b>Credit:</b> 5                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To inculcate about the characterization and purification of virus.
- ❖ To acquire knowledge about viral diseases.
- ❖ To get Knowledge on clinical lab techniques
- ❖ To focus the pathogenicity of medically important bacteria
- ❖ To make aware of various emerging diseases

### Unit I: Introduction to Medical Microbiology

15 hrs

**Normal microbial flora of human body,** Host microbe interaction, Collection, transportation and microbiological examination of Clinical Specimens - urine, blood, faeces, cerebrospinal fluid, throat swabs, sputum, pus and wound exudates. Infection – Sources and Types.

### Unit - II Medical Bacteriology

16hrs

Morphology, pathogenicity, clinical features, laboratory diagnosis, prevention and treatment of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella species*, *Vibrio cholerae*, *Mycobacterium tuberculosis*, *M. leprae*.

### Unit - III Medical Mycology

16 hrs

Classification of Medically important Fungi, Superficial Mycoses, Dermatophytic infections: clinical features of various dermatophytic infections, Subcutaneous infection – Mycetoma. Systemic mycosis – *Histoplasma capsulatum*, *Coccidioides immitis*, *Blastomyces dermatitidis*, Opportunistic mycosis – *Candida albicans*, *Cryptococcus neoformans*, *Aspergillus fumigatus*.

### Unit - IV Medical Virology

14 hrs

Morphology, pathogenicity, clinical features, Laboratory diagnosis, prevention and treatment of Herpes simplex virus, Hepatitis – B, Rabies, Polio, Influenza, Measles, SARS, COVID, AIDS.

Morphology, life cycle, pathogenicity and laboratory diagnosis, prevention and treatment of *Entamoeba histolytica*, *Plasmodium vivax*, *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti*.

**Text Books**

1. Ananthanarayan and Panikar's, 2023, Text book of Microbiology, 2<sup>th</sup> Edition, Universities Press (India) Pvt. Ltd, Hyderabad.
2. Amitha Biswas, 2007, An Introduction To Viruses, Vikas Publishers, New Delhi.
3. Jawetz E., Melnick J.L. Adelberg E.A. 2007, Medical Microbiology, 24<sup>th</sup> Edition, Tata McGraw Publishing House.
4. Rajan S. 2014, Medical Microbiology, 2<sup>nd</sup> Edition, MJP Publishers, Chennai
5. Abigail A. Salyers, Dixie D. Whitt, 2001, Microbiology- Diversity, Disease and The Environment, Fitzgerald Science Press, Bethesda, Maryland, USA
6. Joanne M. Willey, Kathleen M. Sandman, Dorothy H. Wood, 2023, Prescott's Microbiology, 12<sup>th</sup> Edition, McGraw Hill Inc, New York.
7. Baveja C.P. 2022, Textbook of Microbiology, 7<sup>th</sup> Edition, ARYA Publishing Company, New Delhi.

**Reference Books:**

1. Prescott L.M, Harley J.P and Klein D.A., 2014, Microbiology 9<sup>th</sup> Edition, Wm C.
2. Jeffrey C, Pommerville, 2014, Alcamo's Fundamentals of Microbiology, Jones & Bartlett Student Edition, 10<sup>th</sup> Edition, Jones and Bartlett India Pvt, Ltd, New Delhi.
3. Arora D.R, Late Brij Bala Arora, 2020, Text Book of Microbiology, 6<sup>th</sup> Edition, CBS Publishers & Distributors Pvt Ltd. New Delhi.
4. Michael T, Madigan John M, Martinko, Kelly S. Bernder, Daniel H. Buckley and David A Stattl, 2017, Brock Biology Of Microorganisms, 14<sup>th</sup> Edition, Pearson India Education services Pvt Ltd, India.
5. Brown Publishers Patric R Murray, Medical Microbiology, 1990, Mosby Publications.
6. Lansing M. Prescott., John P. Harley, and Donald A. Klein., 2003, Microbiology, 5<sup>th</sup> edition, McGraw Hill, New York.
7. Dimmock N.J, Primrose S.B, 1994, Introduction to Modern Virology. 4<sup>th</sup> Edition. Blackwell Scientific Publications, Oxford.

**Course Outcomes:**

After completion of this course, students would be able to

| S.No. | Course Outcomes                                    | Knowledge Level |
|-------|----------------------------------------------------|-----------------|
| CO1   | Examine the clinical specimens                     | K4              |
| CO2   | Define the clinical features of bacterial diseases | K1              |
| CO3   | Identify the medically important fungi             | K2              |
| CO4   | Evaluate and compare the various viral pathogens   | K4              |
| CO5   | Analyse the various parasitic diseases             | K4              |

| Title of the Course: Medical Microbiology |                          |     |     |     |     | Course Code:U4R3MBCC7              |       |       |       |       |                   |
|-------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                     | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                           | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                       | 3                        | 3   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.7               |
| CO2                                       | 3                        | 3   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.7               |
| CO3                                       | 3                        | 3   | 2   | 2   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.7               |
| CO4                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO5                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
|                                           | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.78              |
|                                           | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

### MAJOR PRACTICAL - IV –(Covering – CC7 - MEDICAL MICROBIOLOGY)

|                                                |                                      |
|------------------------------------------------|--------------------------------------|
| <b>Course Code:</b> U4R3MBCC8P                 | <b>Credit:</b> 5                     |
| <b>Category:</b> Core Practical                | <b>Hrs/Week:</b> 05                  |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40+ Ext: 60 = 100 |

#### Course Objectives:

- ❖ To learn the concentration of bacteriophages
- ❖ To understand the isolation of bacteriophage
- ❖ To Know the difference between gram positive and gram negative bacteria
- ❖ To perceive the Germ tube techniques
- ❖ To acquire knowledge on Minimum Inhibitory Concentration

1. Isolation of Bacteria from Urine, Stool and Sputum
2. Identification of Gram positive organisms; *Streptococcus pneumonia*, *Staphylococcus aureus* and *Bacillus* spp. and Gram Negative organisms: *Escherichia coli*, *Proteus* sp and *Klebsiella pneumoniae* on the basis of Morphological, Cultural and Biochemical characteristics.
3. Examination of cyst, egg of Protozoa, Helminth from stool sample - Saline and iodine wet mount.
4. Examination of Plasmodium – Leishman stain and Geimsa stain.
5. Identification of fungi - KOH and Lactophenol Cotton blue mount
6. Identification of *Candida albicans* - Germ tube technique
7. Antibacterial sensitivity test – Kirby – Bauer method
8. Minimal Inhibition Concentration (MIC)
9. Minimal Bactericidal Concentration (MBC)

#### References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.
3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams & Wilkin Publishers.
4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

**Course Outcomes:**

After completion of this course, students would be able to

| S.No. | Course Outcomes                                       | Knowledge Level |
|-------|-------------------------------------------------------|-----------------|
| CO1   | Demonstrate the blood parasites                       | K1              |
| CO2   | Interpret the isolation of bacteria                   | K2              |
| CO3   | Identify the gram positive and gram negative bacteria | K3              |
| CO4   | Experiment with Germ tube techniques                  | K3              |
| CO5   | Determine Minimum Inhibitory Concentration            | K5              |

| Title of the Course:Major Practical - IV |                          |     |     |     |     | Course Code:U4R3MBCC8P             |     |     |     |     |                   |
|------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-----|-----|-----|-----|-------------------|
| Course Outcomes (COs)                    | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |     |     |     |     | Mean Score of COs |
|                                          | PO1                      | PO2 | PO3 | PO4 | PO5 | PO1                                | PO2 | PO3 | PO4 | PO5 |                   |
| CO1                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO2                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO3                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO4                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
| CO5                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3   | 3   | 3   | 3   | 3.0               |
|                                          | Mean Overall Score       |     |     |     |     |                                    |     |     |     |     | 3.0               |
|                                          | Result                   |     |     |     |     |                                    |     |     |     |     | High              |

## VERMITECHNOLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U4R3MBSEC5:1              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To learn the basic principles of biological, chemical and environmental concepts pertaining to Vermitechnology
- ❖ To know the morphological characteristics of earthworms
- ❖ To understand the different applications of vermiculture
- ❖ To develop skill in marketing and research fields
- ❖ To create knowledge on Self-Employment Opportunity

### Unit –I Scope and Importance of Vermiculture

8 hrs

Definition, History, Scope and importance – common species for Vermiculture, Environmental requirements–culture methods–Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage, Vermiwash-Preparation and its application.

### Unit-II Morphology of earthworm

6 hrs

Taxonomic position and diversity of earthworms - Types – morphology and physiology of earthworm – Ecological roles and needs for earthworm culture / wormery breeding techniques–indoor and outdoor cultures –monoculture and polyculture – relative merits and demerits.

### Unit-III Application of Vermiculture

6 hrs

Applications of vermiculture – vermin – composting, use of Verm castings in organic farming / horticulture – earthworms for management of biomedical solid waste – feed/bait for capture /culture fisheries–forest regeneration. Nutrient Composition of the Vermicompost.

**Unit-IV Marketing of Vermiculture****6 hrs**

Marketing the products of vermiculture - Cost – benefit analysis- qualitycontrol, marketresearch,marketing techniques – creating the demand by awareness, demonstration and advertisement – packing and transport – direct marketing,

**Unit-V Future Perspective of Vermiculture****4 hrs**

Future perspectives – Predators/ pathogen control in wormeries – potential and constraints for vermiculture in India other countries. Financial Support and Government Schemes for setting up Vermicompost – MIDH, NABARD, PIB, NMSA.

**Text Books:**

1. Seetha Lakshmy M, Santhi R, 2017, Vermitechnology, Saras Publications.
2. Mary Violet Christy A, 2008, Vermitechnology, MJP Publishers
3. Kumar, A, 2005, Verms & Vermitechnology. India: APH Publishing Corporation.
4. Clive A. Edwards, Norman Q. Arancon, Rhonda L. Sherman, 2010, Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. United States: CRC Press.
5. Dilip Nandwani Farming for Sustainable, 2016, Organic Agriculture, Germany: Springer International Publishing.

**Reference Books:**

1. Christy, A. M. V, 2014, Vermitechnology. India: MJP Publisher.
2. Jordan E. L, Verma P. S, 2001, Invertebrate Zoology. Italy: S. Chand Limited.
3. SeethalekshmyM, Santhi R, 2014, Vermitechnology, 2nd edition. Saras Publication.
4. Shukla G. S, Upadhyay V. B, 1994, Economic Zoology. India: Rastogi publications.
5. Lee K. E, 1985, Earthworms, their ecology and relationships with soils and land use. Austria: Academic Press.

**Course Outcomes:**

After completion of this course work students would be able to

| S.No. | Course Outcomes                                 | Knowledge Level |
|-------|-------------------------------------------------|-----------------|
| CO1   | Select better vermicompost bed preparation      | K1              |
| CO2   | Identify morphological characters of earthworms | K2              |

|     |                                               |    |
|-----|-----------------------------------------------|----|
| CO3 | Explain the applications of earthworms        | K3 |
| CO4 | Develop skill in marketing and research field | K6 |
| CO5 | Find the self-employment opportunity          | K5 |

| Title of the Course: Vermitechnology |                          |     |     |     |     | Course Code: U3R3MBSEC5:1          |       |       |       |       |                   |
|--------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                      | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                  | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO2                                  | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO3                                  | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO4                                  | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO5                                  | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 1     | 2.8               |
|                                      | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.88              |
|                                      | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## APICULTURE

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U4R3MBSEC5:2              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ To understand the biology of honey bees.
- ❖ To study on honey bee colony establishment.
- ❖ To develop knowledge on honey extraction.
- ❖ To understand the diseases of honey bees and their control.
- ❖ To gain information on financial assistance and funding agencies for bee keeping industry

### Unit I: 6 Hrs

**Biology of Bees: Honeybee** – Systematic position – Species of Honey bees – Life history of Honey bee – behaviour – swarming – Pheromone.

### Unit II: 6 Hrs

**Social life in Bees: Bee colony** – Castes – natural colonies and their yield – Types of bee hives – Structure – location, care and management.

### Unit III: 6 Hrs

**Bee Rearing: Apiary** – Care and Management – Artificial bee hives – types – construction of spaceframes – Selection of sites – Handling – Maintenance – Instruments employed in Apiary – Extraction instruments.

### Unit IV: 6 Hrs

**Bee Economy:** Honey – Composition – uses – Bee wax and its uses – yield in national and international market – Diseases of honey bees and their control methods. Economics of bee culture.

### Unit V: 6 Hrs

**Entrepreneurship: venture** – Preparing proposals for financial assistance and funding agencies – Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.

### Text Books:

1. Dr. Sartaj Ahmad Allayie, Dr. Junaid Ahmad Malik, Prof. Gowhar Rashid, 2022, Apiculture, First Edition, World Biologica.

2. Dr. M. Tamil Selvi, Dr. H. Abdul Jaffar Ali, 2018, A Text Book on Apiculture, Vijay Nicole Imprints Pvt. Ltd.
3. Dharam P. Abrol, 2022, Text Book of Beekeeping, First Edition, Scientific Publisher.
4. Plerre Jean, 1994, Apiculture, sixth Edition, Prost.
5. Dr. D.K.Belsara, Dr.Rakesh Kumar Singh, Dr. Shashikala, B.Belsare, Ravi H, Deshmulch, 2015, Text Book of Apiculture(Beekeeping), Sixth Edition, Himalaya Publishing House Pvt. Ltd.

#### Reference Books:

- 1.Conrad, R., 2013. Natural beekeeping: organic approaches to modern apiculture. Chelsea Green Publishing.
- 2.Chand, Bovinder, Indu Kumari, and Rajesh Kumar, 2021, "Evolution of Apiculture, History and Present Scenario Honey, CRC Press.
- 3.Macfie, D. T. (2013). Practical bee keeping and honey production. Read Books Ltd.
- 4.Kumar, R., Agrawal, O.P. and Hajam, Y.A. eds., 2021, Honey: A Miraculous Product of Nature. CRC Press.
- 5.Brown, R., 2021, Beekeeping-A Seasonal Guide. Batsford Books.

#### Course Outcomes:

After completion of this course work students would be able to

| S.No. | Course Outcomes                                                    | Knowledge Level |
|-------|--------------------------------------------------------------------|-----------------|
| CO1   | Understand the systematic position of honey bee.                   | K1              |
| CO2   | Reveal the different stages and types of bees                      | K2              |
| CO3   | Describe the practice of bee rearing process                       | K3              |
| CO4   | Compare and contrast the composition of honey and bee wax          | K6              |
| CO5   | Clarify the proposal for financial assistance and funding agencies | K5              |

| Title of the Course: Apiculture |                          |     |     |     |     | Course Code: U3R3MBSEC5:2          |       |       |       |       |                   |
|---------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)           | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                 | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO2                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO3                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO4                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO5                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 1     | 2.8               |

|  |                           |             |
|--|---------------------------|-------------|
|  | <b>Mean Overall Score</b> | <b>2.88</b> |
|  | <b>Result</b>             | <b>High</b> |

### **MEDICAL LAB TECHNOLOGY**

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U4R3MBSEC6:1              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

#### **Course Objectives:**

- ❖ To learn about the blood system and their functions.
- ❖ To get knowledge on cardiovascular system.
- ❖ To clear ideas about diagnostic pathology and laboratory safety.
- ❖ To become aware of laboratory safety measures
- ❖ To create knowledge on kidney, liver function and urine analysis

#### **Unit-I Hematology**

**6hrs**

**Composition of Blood and their functions**-Collections of blood-types of Anemia-Mechanism of blood coagulation-Bleeding time, Clotting time, Determination of Hemoglobin, Erythrocyte Sedimentation Rate(ESR),Packed Cell Volume(PCV)-Total count of RBC and WBC-Differential Count of WBC, Platelet count, Reticulate Count-Absolute Eosinophil count. Estimation of Blood Cholesterol.

#### **Unit-II Physiology**

**6 hrs**

Cardiovascular system- Cardiac cycle - Blood Pressure and Pulse - Regulation of heart rate, Cardiac Shock. Heart sounds, Electro Cardiogram-Significance, Ultra Sonography-Ultrasonic Diagnostic methods-Computer Tomography.

#### **Unit-III Diagnostic Pathology**

**6 hrs**

Handling and labeling of histology specimens, tissue processing of histological tissues for paraffin embedding, block preparation. Microtome-type of microtome, sectioning-Staining-staining methods-Mounting – problems encountered during section cutting and remedies-Frozen section technique-freezing microtome.

#### **Unit-IV Laboratory Safety**

**6hrs**

Role of Medical Lab Technologist, ethics, responsibility, safety measure and hazards in clinical biochemistry lab and first aid in laboratory accidents. Glassware's & plastic ware's used in lab, calibration of volumetric apparatus, cleaning & care maintenance.

### **Unit-V Clinical Biochemistry**

**6hrs**

Liver function test-Serum bilirubin – SGPT-SGOT- Alkaline phosphatase and Urine analysis- Bile salts- Bile pigments and Urobilinogen. Kidney Function Test- Urea, uric acid and Creatinine.

#### **Text Books:**

1. Mukherjee KL, 1994, Medical Laboratory Technology, Vol. I, II, III, IV, Tata McGraw Hill Publications, New Delhi.
2. Mukherjee KL, Ghosh S, 2010, Medical Laboratory Technology, 2<sup>nd</sup> Edition, TATA McGraw Hill Publishing Pvt. Ltd. New Delhi.
3. Nagoba B.S. Clinical Microbiology, BI Publications Pvt. Ltd. New Delhi
4. Connie R. Mahon, George Manuselis 2001, Text book of Diagnostic Microbiology, Saunders, USA.
5. Baker F.J, Silverton R.E, Pallister C.J, 2005, Introduction to Medical Laboratory Technology, 7<sup>th</sup> Edition, Hodder Arnold, CBS Publishers and Distributors Pvt. Ltd, New Delhi.
6. Praful B. Godkar, and Darshan P. Godkar, 2021, Textbook of Medical Laboratory Technology - Vol 1 and 2, Bhalani Publishing House, Mumbai.
7. Ananthanarayan R, and Jayaram Paniker CK, 2020, Textbook of Microbiology, 11<sup>th</sup> Edition, Universities Press (India) Pvt. Ltd.
8. Vasudevan D.M., Sreekumari S, Kannan Vaidyanathan, 2023, Text Book of Biochemistry, 10<sup>th</sup> Edition, Jaypee Brothers Medical publishers, New Delhi
9. Keith Wilson, John Walker, 2010, Principles and Techniques of Biochemistry and Molecular Biology, 7<sup>th</sup> Edition, Cambridge University Press, UK
10. Arumugam N. 2016, Human Physiology, Saras publications, Tamilnadu

#### **Reference Books:**

1. Ochei A, Kolhatkar A, 2000, Medical Laboratory Science: Theory and Practice, McGraw Hill Education
2. Ramnik Sood, 2015, Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2<sup>nd</sup> Edition, Jaypee Brothers Medical Publishers, New Delhi.
3. Frances T Fischbach, Margaret A. Fischbach, Kate Stout, 2017, Fischbach's A Manual of Laboratory and Diagnostic Tests, 11<sup>th</sup> Edition, Lippincott Williams & Wilkins Publishers, Philadelphia, USA.

4. Rutherford B.H. Gradwohl, and A.C. Sonnenwirth L. Jarett, 2000, Gradwohls Clinical Laboratory Methods and Diagnosis, Vol-I, 8<sup>th</sup> Edition, Mosby Publishers
5. Godkar, 2021, Textbook of Medical Laboratory Technology, 3<sup>rd</sup> Edition, Bhalani Publishing House, Mumbai.
6. James G Cappucino, and Natalie Sherman, 2016, Microbiology – A laboratory manual, 5<sup>th</sup> Edition, The Benjamin Publishing Company, New York.

### Course Outcomes

After completion of this course, students would be able to

| S.No. | Course Outcomes                                  | Knowledge Level |
|-------|--------------------------------------------------|-----------------|
| CO1   | Explain the types of anaemia                     | K6              |
| CO2   | Illustrate the cardiovascular System             | K2              |
| CO3   | Determine the diagnostic Pathology               | K5              |
| CO4   | Describe the calibration of volumetric apparatus | K3              |
| CO5   | Elaborate the urine analysis                     | K6              |

| <b>Title of the Course:</b> Medical Lab Technology |                           |     |     |     |     | <b>Course Code:</b> U4R3MBSEC6:1   |       |       |       |       |                   |
|----------------------------------------------------|---------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                              | Programme Outcomes (POs)  |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                                    | PO1                       | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                                | 3                         | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO2                                                | 3                         | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO3                                                | 3                         | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO4                                                | 3                         | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO5                                                | 3                         | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
|                                                    | <b>Mean Overall Score</b> |     |     |     |     |                                    |       |       |       |       | <b>3.0</b>        |
|                                                    | <b>Result</b>             |     |     |     |     |                                    |       |       |       |       | <b>High</b>       |

## VACCINOLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U4R3MBSEC6:2              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To provide knowledge on the basics of immunization and induction of immunity.
- ❖ To learn the types of vaccines and its immunological effects and regulatory guidelines.
- ❖ To study the role of rDNA in vaccine technology.
- ❖ To get acquire the knowledge on conventional to recent technology of vaccine production.
- ❖ To know about ethical issues and regulations in vaccine production and clinical trials.

### Unit I: History

4 hrs

History of vaccination, Active and passive immunization; requirements for induction of immunity, Epitopes, linear and conformational epitopes, characterization and location of APC, MHC and immunogenicity.

### Unit II: Vaccine- Viral/bacterial/parasite

8 hrs

Viral/bacterial/parasite vaccine differences, methods of vaccine preparation – Live, killed, attenuated, sub unit vaccines; Licensed vaccines, Viral Vaccine - Poliovirus vaccine-inactivated & Live, Rabies vaccines, Hepatitis A & B vaccines, Bacterial Vaccine - Anthrax vaccines, Cholera vaccines, Diphtheria toxoid, Parasitic vaccine - Malaria Vaccine.

### Unit III: Vaccine technology

6 hrs

Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines. Recent advances in Malaria, Tuberculosis, HIV.

### Unit IV: Vaccine Design

6 hrs

Fundamental research to rational vaccine design. Antigen identification and delivery, T-Cell expression cloning for identification of vaccine targets for intracellular pathogens, Rationale vaccine design based on clinical requirements: Scope of future vaccine strategies.

**Unit V: Vaccine Marketing****6hrs**

Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Quality control and regulations in vaccine research, Animal testing, Rational design to clinical trials, Large scale production, Commercialization. Vaccine safety ethics and Legal issues.

**Text Books:**

1. Ronald W. Ellis, 2001, New Vaccine Technologies, CRC Press.
2. Cheryl Barton, 2009, Advances in Vaccine Technology and Delivery, Espicom Business Intelligence.
3. David K. Male, Jonathan Brostoff, David Roth, Ivan M. Roitt, 2006, Immunology, 7<sup>th</sup> Edition. Mosby Publication, New York.
4. Janis Kuby, Thomas J. Kindt, Richard Goldsby, Barbara A. Osborne, 2000, Immunology, 6<sup>th</sup> Edition, W.H. Freeman and Company, New York.
5. Brostoff J, Seaddin JK, Male D, Roitt IM, 2002, Clinical Immunology, 6<sup>th</sup> Edition, Gower Medical Publishing, UK.

**Reference Books:**

1. Stanley A. Plotkin, Walter Orenstein, Paul A. Offit, 2013, Vaccines, 6<sup>th</sup> Edition, BMA Medical Book Awards Highly Commended in Public Health, Elsevier Publication, Saunders, USA.
2. Richard Coico, Geoffrey Sunshine, Eli Benjamini, 2003, Immunology: A Short Course, 5<sup>th</sup> Edition, Wiley–Blackwell, UK
3. Peter Parham, 2014, The Immune System, 4<sup>th</sup> Edition, W.W. Norton & Company, USA.
4. Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, 2021, Cellular and Molecular Immunology, 10<sup>th</sup> Edition, Elsevier, Pennsylvania.
5. Weir D.M, John Stewart, 1997, Immunology, 8<sup>th</sup> Edition, Churchill Livingstone, New York.

**Course Outcomes**

After completion of this course, students would be able to

| S.No. | Course Outcomes                                                                                                  | Knowledge Level |
|-------|------------------------------------------------------------------------------------------------------------------|-----------------|
| CO1   | Explain the significance of critical antigens, immunogens and adjuvants .                                        | K2              |
| CO2   | Elaborate the types of vaccines.                                                                                 | K6              |
| CO3   | Construct vaccine applying rDNA technology.                                                                      | K3              |
| CO4   | Describe the strategies for developing an innovative vaccine technology with different mode of vaccine delivery. | K5              |

|     |                                                                                        |    |
|-----|----------------------------------------------------------------------------------------|----|
| CO5 | Evaluate the regulatory issues and guidelines for the management of vaccine production | K2 |
|-----|----------------------------------------------------------------------------------------|----|

| Title of the Course: Vaccinology |                          |     |     |     |     | Course Code: U4R3MBSEC6:2          |       |       |       |       |                   |
|----------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)            | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                  | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                              | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO2                              | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.9               |
| CO3                              | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.9               |
| CO4                              | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.9               |
| CO5                              | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.9               |
|                                  | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.88              |
|                                  | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## FOOD AND DAIRY MICROBIOLOGY

|                                                |                                               |
|------------------------------------------------|-----------------------------------------------|
| <b>Course Code:</b> U5R3MBCC9                  | <b>Credit:</b> 4                              |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 5, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ EXT: 75 = 100          |

### Course Objectives

- ❖ To gain information about the microorganisms related to food
- ❖ To give an insight on food contamination and spoilage
- ❖ To impart current knowledge on food preservation
- ❖ To study about the production of fermented dairy products
- ❖ To get knowledge on microbial enzymes

### Unit I - Introduction

15 Hrs

General Introduction of Foods and Related Microorganisms. Intrinsic Factors- Nutrient Content, pH and Buffering Capacity, Redox Potential, Antimicrobial Barriers and Constituents and Water Activity. Extrinsic Factors- Relative Humidity, Temperature and Gaseous Atmosphere.

### Unit II- Food Contamination and Spoilage

15 Hrs

Contamination and Spoilage of Cereals, Cereal Products, Fruits, Vegetables, Meats, Meat Products, Fish, Sea Foods, Eggs, Poultry and Canned Foods. Food Poisoning and Food Borne Infections (Bacterial, Viral, Fungal and Protozoa), Bacterial and Fungal Toxins.

### Unit III- Food Preservation

15 Hrs

Food as a substrate for micro organisms -.Microorganisms important in food microbiology; Molds, yeasts and bacteria. Principles of food preservation - Asepsis - Removal of micro organisms, - High temperature - Low temperature - Drying - Food additives.

### Unit IV- Dairy Microbiology

15 Hrs

Dairy Microbiology- Normal Flora of Milk and Milk Products, Spoilage of Milk and Milk Products. Fermented Milk Products- Acidophilus Milk, Bifidus Milk, Yoghurt Manufacture of Cheese and Evolution of Quality Milk. Microbial Food Fermentation- Fermentation in Food Processing, Role of Microorganisms in Food Fermentation. Microbial Products of Food; SCP, Mushrooms, Oriental Foods Fermented Beverages (Fruit and Cereal Based).

Industrial Production of Enzymes- Cellulases, Amylases, Proteases, Phytases, Pectinases, Lipases and Glucose Isomerases. Food Sanitation – Microbiology of Food Plant Sanitation, Water and Milk Testing. Food Laws and Quality Control – HACCP, Codex Alimentarius, PFA, FPO, MFPO, BIS and AGMARK.

**Text Books**

1. Frazier C William, Westhoff C Dennis ., 2014, Food Microbiology , Fifth Edition , Mc.Graw Hill Publication, New Delhi.
2. Adams.MR , Moss.MO ., 1996, Food Microbiology. First Edition, New Age International P.Ltd.
3. Vijaya Ramesh K., 2007. Food Microbiology, MJP Publishers.
4. Ramanathan N., 2009, A Text Book of Food Microbiology , Om Sakthipathippagam.
5. Prajapati.JB., 1995, Fundamentals of Dairy Microbiology . Prakashan Nadiad.

**Reference Books**

1. Doyle, M.P., Diez-Gonzalez, F. and Hill, C. eds., 2020, Food microbiology: fundamentals and frontiers. John Wiley & Sons.
2. Matthews, K.R., Kniel, K.E. and Montville, T.J., 2017, Food microbiology: an introduction. John Wiley & Sons.
3. Jay, J.M., Loessner, M.J. and Golden, D.A., 2006, Modern food microbiology. Springer Science & Business Media.
4. Robinson, R.K. ed., 2005, Dairy microbiology Handbook: the microbiology of milk and milk products. John Wiley & Sons.
5. Fernandes, R. ed., 2009, Microbiology handbook: dairy products. Royal Society of Chemistry

**Course Outcomes:**

**After completion of this course, students would be able to**

| S.No. | Course Outcomes                                               | Knowledge Level |
|-------|---------------------------------------------------------------|-----------------|
| CO1   | Gain knowledge about food as a substrate for various microbes | K2              |
| CO2   | Acquire a thorough understanding of spoilage of food          | K2              |
| CO3   | Gain information about preservation of food                   | K2              |
| CO4   | Learn about the dairy products                                | K3              |
| CO5   | Describe the food laws and quality control                    | K5              |

| <b>Title of the Course:</b> Food and Dairy Microbiology |                                 |            |            |            |            | <b>Course Code:</b> U5R3MBCC9             |              |              |              |              |                          |
|---------------------------------------------------------|---------------------------------|------------|------------|------------|------------|-------------------------------------------|--------------|--------------|--------------|--------------|--------------------------|
| <b>Course Outcomes (COs)</b>                            | <b>Programme Outcomes (POs)</b> |            |            |            |            | <b>Programme Specific Outcomes (PSOs)</b> |              |              |              |              | <b>Mean Score of COs</b> |
|                                                         | <b>PO1</b>                      | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PS O1</b>                              | <b>PS O2</b> | <b>PS O3</b> | <b>PS O4</b> | <b>PS O5</b> |                          |
| <b>CO1</b>                                              | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.9                      |
| <b>CO2</b>                                              | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.9                      |
| <b>CO3</b>                                              | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.9                      |
| <b>CO4</b>                                              | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.9                      |
| <b>CO5</b>                                              | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.9                      |
|                                                         | <b>Mean Overall Score</b>       |            |            |            |            |                                           |              |              |              |              | <b>2.9</b>               |
|                                                         | <b>Result</b>                   |            |            |            |            |                                           |              |              |              |              | <b>High</b>              |

## ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBCC10                 | <b>Credit:</b> 4                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To inculcate the spread of air born and water borne diseases
- ❖ To Acquire the knowledge of Aquatic ecosystem
- ❖ To know the physico chemical characteristics of soil and role of microbes in improving soil fertility.
- ❖ To become familiar with some important Indian crop diseases
- ❖ To know the solid and liquid waste management

### Unit I: Aeromicrobiology

15hrs

Composition of air, kinds of organisms in air, distribution and sources. Droplets nuclei, aerosol and infectious dust, assessment of air quality. Air – borne diseases.

### Unit II: Aquatic ecosystems

15hrs

Types of aquatic ecosystems: fresh water – ponds, lakes, streams. Marine habitats –estuaries, mangroves, deep sea, saltpan, coral reefs. Zonation – upwelling – eutrophication. Potability of water - microbial assessment of water quality – water purification: Reverse Osmosis, Filtration, UV Radiation. Water borne diseases.

### Unit III: Soil Microbiology

14hrs

Soil microbiology - Introduction – Soil as an environment for microorganisms. Classification of soil, physical and chemical properties of soil, soil microorganisms – biogeochemical cycles – C, N and P.

### Unit IV: Microbial interactions

16hrs

Microbial interactions definition and types - mutualism, commensalism, amensalism – synergism - parasitism – predation - competition. Plant diseases – bacterial (blight of paddy, citrus canker), fungal diseases (late blight of potato, stem rust of wheat), viral diseases (tobacco mosaic virus, cucumber mosaic virus).

### Unit V: Waste management

15hrs

Types of wastes – solid and liquid waste treatment. Solid waste treatment – saccharification – gasification – composting. Liquid waste treatment – primary –secondary – tertiary treatment. Utilization of liquid and solid wastes – food (SCP) –fuel (methane), Biofuel.

### Text Books

1. Subba Rao N.S.,2005, Soil Microbiology, Fourth Edition, Oxford and IBH Publishing Co- P.Ltd.,New Delhi.

- Sharma PD.2005, Environmental Microbiology , Narosa Publishing House P.Ltd, New Delhi.
- Joseph C .Daniel., 1999,Environment Aspects of Microbiology ,First Edition, Brightson Publications.
- Atlas Ronald .M.,Barta and Richard.,2008, Microbial Ecology,Fourth Edition,Benjamin Commings publishing Company, Calofornia.
- Vijaya Ramesh. K. 2007, Environmental Microbiology,Firat Edition, MJP Publishers,Chennai.

#### Reference Books

- Paul, E. and Frey, S. eds., 2023, Soil microbiology, ecology and biochemistry. Elsevier.
- Subba, Rao., 2017, Soil microbiology. Oxford and IBH Publishing.
- Tronsmo, A.M., Collinge, D.B., Djurle, A., Munk, L., Yuen, J. and Tronsmo, A., 2020, Plant pathology and plant diseases. CABI.
- Ravichandra, N.G., 2013, Fundamentals of plant pathology. PHI Learning Pvt. Ltd.
- Pepper, I.L. and Gerba, C.P., 2015, Aeromicrobiology and in Environmental Microbiology , Academic Press.

#### Course Outcomes:

After completion of this course, students would be able to

| S.No. | Course Outcomes                                       | Knowledge Level |
|-------|-------------------------------------------------------|-----------------|
| CO1   | Describe the microorganisms present in air            | K2              |
| CO2   | Explain population dynamics of various marinehabitats | K2              |
| CO3   | Interpret the microorganisms present in the soil      | K2              |
| CO4   | Define the microbial interactions                     | K3              |
| CO5   | Manipulate the waste management                       | K5              |

| Title of the Course: Environmental and Agriculture Microbiology |                          |     |     |     |     | Course Code: U3R3MBCC10            |       |       |       |       |                   |
|-----------------------------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                                           | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                                                 | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO2                                                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO3                                                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO4                                                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO5                                                             | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
|                                                                 | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.8               |
|                                                                 | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## MOLECULAR BIOLOGY AND MICROBIAL GENETICS

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBCC11                 | <b>Credit:</b> 5                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To familiarize with the basic knowledge in Nucleic Acids
- ❖ To understand the replication process
- ❖ To know the gene transcription mechanism
- ❖ To get knowledge on the mutation process
- ❖ To study the gene transfer mechanisms

### Unit I - Nucleic Acids

15 hrs

Central Dogma of Life, Definition and Functions of DNA and RNA - Structure of double helix DNA, different forms of DNA: A - DNA, B - DNA, Z - DNA – Types of RNA: mRNA, rRNA, tRNA- Difference between DNA and RNA. DNA as a Genetic Material – Experimental Proof.

### Unit II – Replication

15 hrs

DNA replication – Conservative, Semiconservative - Meselson and Stahl's experiment - enzymology of DNA replication. Unidirectional and Bidirectional replication, various models of DNA Replication– rolling circle model – theta model, D-loop. Replication of RNA – reverse transcriptase.

### Unit III – Transcription

15 hrs

Prokaryotic transcription - RNA polymerase - structure and function. Initiation of transcription- promoters - elongation, termination - Rho-dependent and Rho independent process. Eukaryotic Transcription Process. Post transcriptional modifications in Prokaryotes and Eukaryotes. Genetic Code.

### Unit IV - Gene mutation and repair

15 hrs

Mutation & types of mutations - physical & chemical mutagenesis - Ames test - Toxicity testing. DNA damage and repair: Excision repair, Photo reactivation, Recombinational repair and SOS repair.

Transformation - competence, DNA uptake and mechanism of transformation. Transduction: Generalized and Specialized transduction. Conjugation-  $F^+$ , Hfr,  $F'$  transfer. Transposons -Simple and composite transposon - transposition process.

**Text Books:**

1. Sambamurthy A.V.S.S. 2008, Molecular Biology, Narosa Publishing House, New Delhi, India
2. Malacinski G.M, 2008, Freifelder's Essentials of Molecular Biology, 4<sup>th</sup> Edition, Narosa Publishing House, New Delhi.
3. Jeyanthi G.P. 2009, Molecular Biology, MJP Publishers, Chennai
4. Rastogi S.C. 2006, Molecular Biology, CBS Publishers & Distributors, New Delhi
5. Robert H. Tamarin, 2002, Principles of Genetics, 7<sup>th</sup> Edition, TATA McGraw-Hill Publishing Company Ltd. New Delhi
6. Brown T.A, 2016, Gene Cloning and DNA Analysis-An Introduction, 7<sup>th</sup> Edition, John Wiley and Sons (India) Ltd.
7. Dale J.W, Schantz M.V, and Plant N, 2012, From Gene to Genomes – Concepts and Applications of DNA Technology, 3<sup>rd</sup> Edition, John Wiley and Sons (India) Ltd.
8. Avinash and Kakoli Upadhyay 2005, Molbio Fundamentals of Molecular Biology, 1<sup>st</sup> Edition, Himalaya Publishing House, Mumbai
9. Stanly R. Maloy, John E. Cronan, Jr. David Freifelder, 2011, Microbial Genetics, 2<sup>nd</sup> Edition, Narosa Publishing House, New Delhi

**Reference Books:**

1. Glick B.R, and Patten CL, 2018, Molecular Biotechnology – Principles and Applications of Recombinant DNA, 5<sup>th</sup> Edition, ASM Press.
2. Peter J. Russell, 2016, iGenetics - A Molecular Approach, 3<sup>rd</sup> Edition, Pearson Education India
3. David L. Nelson, and Cox M.M, 2017, Lehninger- Principles of Biochemistry, 7<sup>th</sup> Edition, WH Freeman, New York.
4. Synder L, Peters J, Henkin T.M, Champness W, 2013, Molecular Genetics of Bacteria, 4<sup>th</sup> Edition, ASM Press, Washington-DC, USA.
5. Primrose S.B, and Twyman R.M, 2013, Principles of Gene Manipulation and Genomics, 7<sup>th</sup> Edition, Blackwell Publishing, Australia.
6. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, 2014, Lewins Genes XI, Jones & Bartlett India Pvt. Ltd. New Delhi

**Course Outcomes:**

After completion of this course, students would be able to

| S.No | Course outcome                                             | Knowledge level |
|------|------------------------------------------------------------|-----------------|
| CO1  | Define about nucleic acids                                 | K1              |
| CO2  | Explain replication of DNA and RNA                         | K2              |
| CO3  | Illustrate the transcription in Prokaryotes and Eukaryotes | K2              |
| CO4  | Determine the Gene mutation                                | K5              |
| CO5  | Explain the Gene transfer mechanism                        | K5              |

| Title of the Course: Molecular Biology and Microbial Genetics |                          |     |     |     |     | Course Code: U5R3MBCC11            |       |       |       |       |                   |
|---------------------------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                                         | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                                               | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                                           | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO2                                                           | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO3                                                           | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO4                                                           | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO5                                                           | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
|                                                               | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.8               |
|                                                               | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

**Practical V–(Covering CC9 & CC10 –FOOD AND DAIRY MICROBIOLOGY &ENVIRONMENTAL AND AGRICULTURE MICROBIOLOGY)**

|                                                |                                       |
|------------------------------------------------|---------------------------------------|
| <b>Course Code:</b> U5R3MBCC12P                | <b>Credit:</b> 4                      |
| <b>Category:</b> Core Practical                | <b>Hrs/Week:</b> 05                   |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40 + Ext: 60 = 100 |

**Course Objectives:**

- ❖ To get knowledge on isolation of bacteria from food
- ❖ To become familiar with the isolation of yeast from grapes
- ❖ To estimate the quality of milk
- ❖ To demonstrate the Arbuscular Mycorrhiza
- ❖ To know the water analysis

1. Assessment of milk quality by Methylene Blue Reduction Test
2. Performance of Phosphatase test for pasteurized milk
3. Isolation of bacteria from food by standard plate count
4. Isolation of Yeast from grapes
5. Lactophenol Cotton Blue wet mount preparation of spoiled bread, tomato, grapes, potato.
6. Preparation of fermented food – Yoghurt and Cheese (Demonstration)
7. Water analysis by MPN technique – presumptive coliform test – confirmed coliform test and completed coliform test.
8. Microbial assessment of air quality – open plate method and air sampler-technique.
9. Isolation and counting of faecal bacteria from water.
10. Soil Analysis – pH, chlorides, nitrate, calcium, magnesium and total phosphorus.
11. Isolation of cyanobacteria from water.
12. Isolation of *Azospirillum*, *Azotobacter* from soil.
13. Isolation of *Rhizobium* from legume nodule.
14. Observation of Arbuscular Mycorrhiza (AM) from plant roots.
15. Isolation and enumeration of soil microorganism.
16. Examination of *Anabaena* from *Azolla* plant

**References:**

1. David M. Sylvia, Jeffry J. Fuhrmann, Peter Hastell, David A. Zuberer, 1st Ed. Prentice Hall.

2. James G. Cappuccino and Natalie Sherman. (1996). Microbiology-A Laboratory Manual (4th edition). The Benjamin publishing company, New York.
3. Russell F. Bey. (2001). Microbiology Laboratory Manual, BROOKS/COLE, Australia.
4. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
5. R.C.Dubey (2002). Microbiology practical manual. S.Chand and Company LTD.
6. Kannan.N (2002) Lab manual in General Microbiology. Panima Publishing Corporation

#### Course Outcomes:

After completion of this course, students would be able to

| S.No. | Course Outcomes                             | Knowledge Level |
|-------|---------------------------------------------|-----------------|
| CO1   | Recall the isolation of yeast from grapes   | K1              |
| CO2   | Explain the isolation of bacteria from food | K2              |
| CO3   | Estimate the soil microorganisms            | K5              |
| CO4   | Assess the quality of air                   | K3              |
| CO5   | Analyse the water samples                   | K5              |

| Title of the Course: Practical V |                          |     |     |     |     | Course Code: U5R3MBCC12P           |       |       |       |       |                   |
|----------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)            | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                  | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                              | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO2                              | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 2.8               |
| CO3                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO4                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO5                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
|                                  | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.92              |
|                                  | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## BIOINFORMATICS

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBDSE5:1               | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective  | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To develop skills of the students in the area of probability and statistics
- ❖ To know about the various reliability methods
- ❖ To learn the basics of computers
- ❖ To provide basic idea of bioinformatics databases and application for the students
- ❖ To know the basic knowledge of sequence alignment

### Unit I: Basic computer

15 hrs

**Introduction to Computers – History of Computers** – its developing technology and generation of Computers – Operating Systems – Windows, Unix – Hardware, Software, disc operating systems.

### Unit II: Internet

15 hrs

Working of Internet – Local area and wide area network – Types of files – HTML, TXT, PDF –Search engines and its types and applications.

### Unit III: Bioinformatics

15 hrs

Introduction to bioinformatics – its history and its development - Applications of Bioinformatics. Biological databases – NCBI, EMBL, DDBJ, PDB, Swiss Prot. Data retrieval- Entrez and SRS.

### Unit IV: Sequence alignment

15 hrs

Introduction to Sequence alignment. Sequence analysis – pairwise sequence comparison. Database search for similar sequences using FASTA and BLAST Programs. Multiple sequence alignments.

### Unit V: Evolutionary analysis

15 hrs

Evolutionary analysis: distances, Cladistic and Phenetic Method. Clustering Methods. Rooted and Unrooted tree representation. Bootstrapping strategies, Uses of Clustal W and PHYLIP, MEGA.

### Text Book

1. Shalini Govil-Pai, 2015, Principles of Computer Graphics: Theory and Practice Using OpenGL and Maya, Springer-Verlag New York Inc.;
2. Puneet Mehrotra, Kumud Sarin, Swapna K.S, 2006, The New Handbook of Bioinformatics. S.Chand (G/L) & Company Ltd
3. David R, Westhead, J, Howard Parish, Richard M. Twyman, 2003, Bioinformatics, Viva Books.

4. Subramanian C, 2014, A Textbook of Bioinformatics Dominant Publishers & Distributors (P) Ltd.
5. Athur M. Lesk, 2019, Introduction to Bioinformatics Bioinformatics OUP Oxford; 5th edition

#### Reference Books:

1. Attwood, T. K., Parry-Smith, D. J, 2003, Introduction to Bioinformatics. India: Prentice Hall.
2. Baxevanis, A. D., Ouellette, B. F. F, 2004, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Germany: Wiley.
3. Gibas, C., Jambeck, P, 2001, Developing bioinformatics computer skills. Germany: O'Reilly.
4. Des Higgins, Willie Taylor, 2000. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach. United Kingdom: Oxford University Press, UK.
5. Harisha, S, 2013, Fundamentals of Bioinformatics. India: I.K. International Publishing House Pvt. Limited.

#### Course Outcomes:

After completion of this course, students would be able to

| S.No. | Course Outcomes                                                          | Knowledge Level |
|-------|--------------------------------------------------------------------------|-----------------|
| CO1   | Gain knowledge on operating systems                                      | K1              |
| CO2   | Infer the concepts of sequence analysis and the prediction of structure. | K2              |
| CO3   | Experiment with the software and its application in research field.      | K3              |
| CO4   | Compare the evolutionary distance between organisms or species.          | K4              |
| CO5   | Test the FASTA and BLAST programs                                        | K6              |

| Title of the Course: Bioinformatics |                          |     |     |     |     | Course Code: U5R3MBDSE5:1          |       |       |       |       |                   |
|-------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)               | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                     | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                 | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO2                                 | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO3                                 | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO4                                 | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO5                                 | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
|                                     | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.5               |
|                                     | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## BIOSAFETY AND BIOETHICS

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBDSE5:2               | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective  | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ To studying the bioethical principles, values, concepts, and social and juridical implications.
- ❖ To assist their application and promotion in the areas of science, biotechnology and medicine.
- ❖ To discuss about various aspects of biosafety regulations, IPR and bioethics concerns.
- ❖ To introduce fundamental aspects of Intellectual property Rights.
- ❖ To understand the importance of IPR, Patents and Patent laws.

### Unit I: Basics of Biosafety

15 hrs

**Laboratory Hazards and Hazard symbols.** Definitions of Biohazard, Biosafety and Biosecurity - LAI, BP, Classification. Biological Risk Groups. Need and application of biosafety. Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP).

### Unit II: Hazardous materials in Biotechnology

15 hrs

Hazardous materials in Biotechnology - Categories of Waste in the Biotechnology Laboratories, Biohazardous waste and their disposal and treatments- issues in use of GMO's, risk for animal/human/ agriculture and environment owing to GMO. Hazardous materials, Emergency response/ first aids in Laboratories.

### Unit III: Biological Safety Containment in Laboratory

15 hrs

**Biological Safety Containment in Laboratory** - Primary and secondary containments - Physical and biological containment. Types of biosafety containments (level I, II, III), PPE, Biosafety guidelines in India - Roles of Institutional Biosafety Committee, RCGM, GEAC.

### Unit IV: Introduction and need of Bioethics

15 hrs

Introduction and **need of Bioethics** - its relationship with other branches, Ethical implications of biotechnological products and techniques. Ethical Issues involving human cloning, human genome project, prenatal diagnosis, agriculture and animal rights, Social and ethical implications of biological weapons.

**IPR, Patents and Patent laws** - Intellectual property rights-TRIP- GATT International conventions patents, Methods of application of patents, Legal implications. Biodiversity and farmer rights, Objectives of the patent system, Basic principles and general requirements of patent law, Biotechnological inventions, and patent law. Legal development-Patentable subjects and protection in biotechnology. The patenting of living organisms.

**Text Books:**

1. Sateesh, M.K., 2014, Bioethics and biosafety. IK International Pvt Ltd, New Delhi.
2. Sree Krishna.V, 2007, Bioethics and Biosafety in Biotechnology, New Age International Publishers, New Delhi.
3. Stanlel A.Shaleesha, 2008, Bioethics Wisdom Educational Service, Chennai.
4. Dubey.R.C, 2014, A Text Book of Biotechnology, Fifth Edition, S. Chand Publishers,new Delhi.
5. Nancy S. Jecker,Albert R.Jonsen, Robert a.Pearlman,2010, Bioethics an Introduction to the
6. History, methods and Practice, Jonsen and Barlett India Pvt,Ltd,New Delhi.

**Reference Books:**

1. Sateesh, M.K., 2013, Bioethics and Biosafety. IK International Pvt Ltd.
2. Joshi, R., 2006, Biosafety and Bioethics. Gyan Publishing House.
3. Ablicieva, I.Y., 2018, Basics of Bioethics and Biosafety.
4. Nambisan, P., 2017, An introduction to ethical, safety and intellectual property rights issues in biotechnology. Academic Press.
5. Uzochukwu, S., Esiobu, N.D., Okoli, A.S., Nwoba, E.G., Christpeace, E.N., Adetunji, C.O., Ibrahim, A.B. and Ubi, B.E. eds., 2022, Biosafety and Bioethics in Biotechnology: *Policy, Advocacy, and Capacity Building*. CRC Press.

**Course Outcomes:**

After completion of this course, students would be able to

| S.No. | Course Outcomes                                                                                         | Knowledge Level |
|-------|---------------------------------------------------------------------------------------------------------|-----------------|
| CO1   | Understand the control measures of laboratory hazards                                                   | K1              |
| CO2   | Develop stratagems for the use of genetically modified organisms and Hazardous materials                | K2              |
| CO3   | Develop skills of critical ethical analysis of contemporary moral problems in medicine and health care. | K3              |
| CO4   | Analyze and respond to the comments of other students regarding philosophical issues                    | K4              |
| CO5   | Pave the way for the students to catch up Intellectual Property(IP) as a career option                  | K6              |

| Title of the Course: Biosafety and Bioethics |                          |     |     |     |     | Course Code: U5R3MBDSE5:2          |       |       |       |       |                   |
|----------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                        | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                              | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                          | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO2                                          | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO3                                          | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO4                                          | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO5                                          | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
|                                              | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.5               |
|                                              | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## MICROBIAL BIOTECHNOLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBDSE6:1              | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Employability    | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ To be aware of the history and scope of biotechnology
- ❖ To familiarize with the enzyme technology
- ❖ To know the microalgal technology
- ❖ To get knowledge about the therapeutic drugs and vaccines
- ❖ To understand the importance of plant and animal biotechnology

### Unit I: History and scope

15 hrs

Biotechnology - Definition – concepts - history, scope and importance, emergence of modern biotechnology - global impact and current excitement of biotechnology (Health care, agriculture, Human Genome Project, Genomics and Proteomics), Biotechnology in India and development.

### Unit II: Enzyme technology

15 hrs

Enzyme production technology through microbes, problems and applications. Enzyme immobilization - definition, advantages of using immobilized enzymes, various methods of immobilization: adsorption, entrapment, ionic bonding, cross linking and encapsulation.

### Unit III: Algal Biotechnology

15 hrs

Single cell protein (algae and yeast). Microalgal technology – Industrial cultivation methods of Spirulina – biotechnological potentials of Spirulina as: food and feed – fuel production from microalgae – pharmaceutically valuable compounds from microalgae. Commercial production of bio-ethanol and bio-diesel using lignocellulosic waste.

### Unit IV: Therapeutic Agents and Vaccines

15 hrs

Microbial production of pharmaceuticals – antibiotics, hormones (insulin), enzymes (streptokinase), recombinant vaccines (Hepatitis B vaccine) - Edible vaccine, Subunit vaccines: Herpes simplex virus, Foot and mouth disease virus, TB, Peptide vaccines, vector vaccines.

**Ti plasmid derived vector systems** - Development of insect, virus and herbicide resistant plants, stress and senescence tolerant plants, modification of flower nutritional content, sweetening by genetic engineering.

**Transgenic animals:** methods of creating transgenic mice, cattle and sheep. Human gene therapy – in vivo and ex vivo gene therapy. Molecular diagnostics for genetic diseases.

**Text Books**

1. Dr. R. C. Dubey, 2022, A Text Book of Microbiology, S Chand and Company Limited.
2. William J. Thiemen, Michael A. Palladino, 2014, Introduction to Biotechnology, Third Edition, Pearson India Education Services Pvt. Ltd.
3. Dr. Prakash S. Loghar, 2012, Text Book of Biotechnology, MJP Publishers.
4. Dr. S. Rajan, R. Selvi Christy, 2016, Essential of Microbiology, Second Edition, CBS Publishers & Distributors Pvt. Ltd.
5. B.D.Singh, 1998, Biotechnology, Kalyani Publishers.

**Reference**

1. Singh, J., Vyas, A., Wang, S. and Prasad, R. eds., 2020, Microbial Biotechnology: Basic Research and Applications, Singapore: Springer.
2. Lee, Y.K. and Anwar, A. eds., 2003, Microbial biotechnology: principles and applications. World Scientific Publishing Company.
3. Khan, F.A., 2020, Biotechnology Fundamentals Third Edition. CRC Press.
4. Glazer, A.N. and Nikaido, H., 2007, Microbial biotechnology: fundamentals of applied microbiology. Cambridge University Press.
5. Yadav, A.N., Singh, J., Singh, C. and Yadav, N. eds., 2021, Current trends in microbial biotechnology for sustainable agriculture. Singapore: Springer.

**Course Outcomes:**

**After completion of this course, students would be able to**

| S.No | Course outcome                                       | Knowledge level |
|------|------------------------------------------------------|-----------------|
| CO1  | Describe History and scope of Biotechnology          | K2              |
| CO2  | Classify various methods of enzyme immobilization.   | K2              |
| CO3  | Develop expertise on fuel production from microalgae | K3              |
| CO4  | Interpret the production of vaccine                  | K2              |
| CO5  | Explain the applications of genetic engineering      | K3              |

| <b>Title of the Course:</b> Microbial Biotechnology |                                     |                 |                 |                 |                 | <b>Course Code:</b> U5R3MBDSE6:1              |                  |                  |                  |                  |                              |
|-----------------------------------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------------------------------------|------------------|------------------|------------------|------------------|------------------------------|
| <b>Course Outcome<br/>s (COs)</b>                   | <b>Programme Outcomes<br/>(POs)</b> |                 |                 |                 |                 | <b>Programme Specific<br/>Outcomes (PSOs)</b> |                  |                  |                  |                  | <b>Mean Score<br/>of COs</b> |
|                                                     | <b>PO<br/>1</b>                     | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PS<br/>O1</b>                              | <b>PS<br/>O2</b> | <b>PS<br/>O3</b> | <b>PS<br/>O4</b> | <b>PS<br/>O5</b> |                              |
| <b>CO1</b>                                          | 3                                   | 2               | 2               | 2               | 2               | 3                                             | 2                | 3                | 2                | 2                | 2.4                          |
| <b>CO2</b>                                          | 3                                   | 2               | 2               | 3               | 3               | 3                                             | 3                | 3                | 2                | 3                | 2.6                          |
| <b>CO3</b>                                          | 3                                   | 3               | 2               | 3               | 3               | 3                                             | 3                | 3                | 2                | 3                | 2.8                          |
| <b>CO4</b>                                          | 3                                   | 3               | 2               | 3               | 3               | 3                                             | 3                | 3                | 2                | 3                | 2.8                          |
| <b>CO5</b>                                          | 3                                   | 3               | 2               | 3               | 3               | 3                                             | 3                | 3                | 2                | 3                | 2.8                          |
|                                                     | <b>Mean Overall Score</b>           |                 |                 |                 |                 |                                               |                  |                  |                  |                  | <b>2.68</b>                  |
|                                                     | <b>Result</b>                       |                 |                 |                 |                 |                                               |                  |                  |                  |                  | <b>High</b>                  |

## MICROBIAL MARKETABLE PRODUCTS

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U5R3MBDSE6:2              | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ Acquire the knowledge about *Spirulina* and its cultivation
- ❖ Gain in depth knowledge about edible mushroom and its cultivation
- ❖ Acquire a thorough understanding of the importance of probiotics in human health
- ❖ Get an awareness of the availability of natural pigment and its application
- ❖ Imbibe knowledge on the various marketing strategy such as patenting, trade mark, marketing, license procurement etc.

### Unit I:

15 Hrs

Morphology and structure of *Spirulina maxima* and *Spirulina platensis*. Biochemical composition, phycobiliprotein, beta carotene and UV Protecting pigments. Methods of cultivation - Freshwater, marine and hyper saline – photobioreactors, plate method, tubular, annular and plate airlift. Tank construction, Race way pond – open and closed - construction, Scale-up cultivation. Contaminants identification and processing. Harvesting, drying and packaging. Uses & Application of Spirulina.

### Unit II:

15 Hrs

Mushroom fungi – *Agaricus* sp., *Calocybe* sp., *Pleurotus* sp., and *Volvariella* sp., biochemical composition, nutrient value, compounds and flavanoids. Cultivation – Tropical and temperate types, growth media preparation - compost, waste recycling, isolation, spawn production; spawn running, harvesting and packing. Construction cultivation shed - Small scale and large scale production setup. Diseases and control measures. Medicinal properties.

### Unit III:

15 Hrs

Introduction probiotics, mechanism of probiotics, Probiotic microorganism- Bacteria and Yeast Structure and cultural characteristics of *Lactobacillus* sp., *Saccharomyces* sp. Nutritional sources, yeast propagation. Cultivation and fermentation techniques: Raw materials, Fermentor design, construction, production, microbial growth requirements, quality testing, stability during storage, packing. Commercial Probiotic dairy products, Health benefits. Safety of probiotics in legal status.

**Unit IV:****15 Hrs**

**Microbial pigments** – allophycocyanin, phycocyanin, phycoerythrin, chlorophyll (Bacterial and cyanobacterial), Pigment proteins applications – medical, industrial and textile, extraction methods. biological nutrient management – organic manures, Biofertilizers – soil improvement, structure and cultural characteristics of *Rhizobium* sp., *Azotobacter* sp., *Azospirillum* sp., *Nostoc* sp. Cultivation – raw material, fermentor design, mass production, harvesting, macro quality analysis, grading, Packaging and post-harvest management.

**Unit V:****15 Hrs**

**General principle of intellectual property rights**, concept of property..Forms of IPR- law of copyrights, Trademark, Patents, industrial design, trade secrets, application of different forms.

**Text Books:**

1. Dubey RC, 2018, Text book of Biotechnology, S.Chand&Company Ltd., New Delhi.
2. Ashutosh Kar, 2022, Text Book of Probiotics, CBS Publishers and Distributors Pvt. Ltd. New Delhi
3. Whitton B.A, and Potts M, 2000, The ecology of Cyanobacteria: their diversity in time and space, Kluwer Academic Publisher, Dordrecht, London.
4. Fritsch F.E, 1935, The Structure and Reproduction of the Algae, Volume 1, 1<sup>st</sup> Edition, Cambridge University Press.
5. Fritsch F.E, 1952, The Structure and Reproduction of the Algae, Volume 2, 1<sup>st</sup> Edition. Cambridge University Press.
6. Leela S.S, and Jyothi Kumar, 2010, Algal BioProcess Technology, 1<sup>st</sup> Edition, New age International Publishing House, New Delhi.
7. Laura Barsanti, Paolo Gualtieri, 2014, Algae: Anatomy, Biochemistry and Biotechnology, 2<sup>nd</sup> Edition. CRC Press, London.
8. Gaur, A.C, 2006, Hand book of Organic Farming and Biofertilizers, Ambica Book Agency
9. Khattar J.I.S, Singh D.P, Kaur, 2009, Algal Biology and Biotechnology - Microalgae: A source of natural colours, 1<sup>st</sup> Edition, IK International Publishing House Pvt. Ltd., New Delhi.
10. Arora, Manish, 2007, Guide to Trademarks, 2<sup>nd</sup> Edition, Universal Publications, New Delhi.

**Reference Books:**

1. Atlas R.M, 1998, Microbial Ecology – Fundamentals and Applications, 4<sup>th</sup> Edition, Pearson Education India.
2. Vessey, 2003, Plant growth-promoting Rhizobacteria as biofertilizers, Plant and Soil, 255:571-586.
3. Dubey R.C, and Maheshwari D.K, 1999, Text book of Microbiology, S. Chand & Company Ltd., India

4. Bahl N, 2000, Handbook on Mushrooms, 4<sup>th</sup> Edition, Oxford & IBH Publishing Co. Pvt Ltd., India.
5. Eiri Board, 2009, Hand Book of Biofertilizers & Vermiculture, Engineers India Research Institute, India.
6. Neeraj P., and Khusdeep D, 2014, Intellectual Property Rights, PHI learning Pvt. Ltd., India
7. Lee Y.K., and Salminen S, 2008, Handbook of Probiotics and Prebiotics, John Wiley & Sons, Inc.
8. Gibson G.R., and Roberfroid M, 2008, Handbook of Prebiotics, 1<sup>st</sup> Edition, CRC Press.

**Course Outcomes:**

After completion of this course, students would be able to

| S.No | Course outcome                                                                                                        | Knowledge level |
|------|-----------------------------------------------------------------------------------------------------------------------|-----------------|
| CO1  | Acquire the knowledge about <i>Spirullina</i> and its cultivation                                                     | K2              |
| CO2  | Gain in depth knowledge about edible mushroom and its cultivation                                                     | K2              |
| CO3  | Acquire a thorough understanding of the importance of probiotics in human health                                      | K3              |
| CO4  | Get an awareness of the availability of natural pigment and its application, Bio fertilizers                          | K2              |
| CO5  | Imbibe knowledge on the various marketing strategy such as patenting, trade mark, marketing, license procurement etc. | K3              |

| Title of the Course: Microbial Marketable Products |                          |     |     |     |     | Course Code: U5R3MBDSE6:2          |       |       |       |       |                   |
|----------------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                              | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                                    | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                                | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO2                                                | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO3                                                | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO4                                                | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
| CO5                                                | 3                        | 2   | 2   | 2   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.5               |
|                                                    | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.5               |
|                                                    | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## INDUSTRIAL MICROBIOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBCC13                 | <b>Credit:</b> 4                               |
| <b>Category:</b> Core Course                   | <b>Hrs/Week:</b> 06, <b>Total Inst.Hrs:</b> 90 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To be aware of the historical background of industrial microbiology and strain improvement methods
- ❖ To study the types of fermentation
- ❖ To know the design of the fermenter
- ❖ To develop skill in downstream process
- ❖ To focus on microbial production

### Unit I: Introduction to Industrial Microbiology

18 Hrs

History and Scope of Industrial Microbiology. Isolation and production strains – Screening Techniques – Primary and Secondary. Strain Development – Mutation, Protoplast fusion and Recombinant DNA Techniques. Preservation techniques – Preparation of inoculum Development.

### Unit II: Production media& Fermentation

18 Hrs

Characteristics of an ideal production medium – Raw Materials. Industrial Sterilization – Principles of Sterilization, Equipment, Production Media and Air. Types of Media – Crude, Synthetic. Types of fermentation.

### Unit III: Fermenter Design

18 hrs

Design of fermenters: Aseptic operation and containment – Aeration and Agitation – Types of fermenters: Batch fermenter, Continuous Stirred Tank fermenter, Tower fermenter, Airlift fermenter, Fluidized Bed fermenter.

### Unit IV: Down Stream Processing

18 Hrs

Recovery and Purification Process - Filtration, Centrifugation, Cell Disruption, Liquid – Liquid extraction, Chromatography, precipitation, Drying, Crystallization, Solvent Recovery, Aqueous two phase extraction

### Unit V: Microbial Production

18 Hrs

Antibiotics (Penicillin, Streptomycin), Vitamins (B2, B12), Enzymes (Amylase, Protease), Solvent (Ethyl Alcohol), Organic acids (Vinegar, Lactic Acid and Citric Acid), Amino acids (L-Glutamic acid, L-Lysine).

### Text Books

1. Stanbury. P.F. Whitaker. A, Hall. S.J.1995, Principles of Fermentation Technology, 2<sup>nd</sup> Edition. Pergamon Press. (Unit IV, V).
2. Patel A.H. 2016, Industrial Microbiology, 2<sup>nd</sup> Edition. Rajiv Berfor MacMillan India Ltd., New Delhi. (Unit I, II, III)
3. Casida, J.R., 2012, Industrial Microbiology. New age international (P) Limited.
4. Kalaichelvan, P T. & Arul Pandi, 2009, Bioprocess Technology. MJP Publishers Chennai.
5. Sathyanarayana. U, 2017, Biotechnology 11<sup>th</sup> Edition, Books and Allied PVT.. Ltd. Kolkata.
6. Dubey R.C., Maheshwari D.K. 2021, A Textbook of Microbiology, 4<sup>th</sup> Edition, S. Chand Publishing, New Delhi

### Reference Books:

1. Gupta P.K., 2016, Elements of Biotechnology, Rastogi publications, Meerut-New Delhi.
2. El-Mansi E.M.T., Bryce C.F.A., Dahhou B., Demain A.L., Allman A.R., 2012, Fermentation Microbiology and Biotechnology, 3<sup>rd</sup> Edition, CRC Press, UK
3. Sibi. G. 2018, Industrial Microbiology and Biotechnology, 1<sup>st</sup> Edition. Himlaya Publishing house, Mumbai
4. Sateesh M.K., 2008, Bioethics and Bio-safety. I.K. International Publishing House Pvt. Ltd.
5. Glick, B.R., Pasternak, J.J., 1994, Molecular Biotechnology, ASM Press, US.
6. Demain A.L. Solomon N.A., 1986, Manual of Industrial Microbiology and Biotechnology ASM Press, US.
7. Prave, P, Faust, V. Sitting, W., Sukatsch. D.A. 1987, Fundamentals of Biotechnology ASM Press.

### Course Outcomes:

After completion of this course, students would be able to

| Sl.No | Course Outcomes                                              | Knowledge Level |
|-------|--------------------------------------------------------------|-----------------|
| CO1   | Describe on historical background of industrial microbiology | K1              |
| CO2   | Explain media formulation strategies                         | K3              |
| CO3   | Operate the different Fermenters                             | K3              |
| CO4   | Develop expertise on downstream process                      | K6              |
| CO5   | Manipulate the industrial products and their environments    | K3              |

| <b>Title of the Course:</b> Industrial Microbiology |                                 |            |            |            |            | <b>Course Code:</b> U6R3MBCC13            |              |              |              |              |                          |
|-----------------------------------------------------|---------------------------------|------------|------------|------------|------------|-------------------------------------------|--------------|--------------|--------------|--------------|--------------------------|
| <b>Course Outcomes (COs)</b>                        | <b>Programme Outcomes (POs)</b> |            |            |            |            | <b>Programme Specific Outcomes (PSOs)</b> |              |              |              |              | <b>Mean Score of COs</b> |
|                                                     | <b>PO1</b>                      | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PS O1</b>                              | <b>PS O2</b> | <b>PS O3</b> | <b>PS O4</b> | <b>PS O5</b> |                          |
| <b>CO1</b>                                          | 3                               | 2          | 2          | 2          | 2          | 3                                         | 2            | 3            | 2            | 2            | 2.3                      |
| <b>CO2</b>                                          | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO3</b>                                          | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO4</b>                                          | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO5</b>                                          | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
|                                                     | <b>Mean Overall Score</b>       |            |            |            |            |                                           |              |              |              |              | <b>2.7</b>               |
|                                                     | <b>Result</b>                   |            |            |            |            |                                           |              |              |              |              | <b>High</b>              |

## Practical VI – (Covering CC11 & CC13 –MOLECULAR BIOLOGY AND MICROBIAL GENETICS &INDUSTRIAL MICROBIOLOGY)

|                                                |                                       |
|------------------------------------------------|---------------------------------------|
| <b>Course Code:</b> U6R3MBCC14P                | <b>Credit:</b> 4                      |
| <b>Category:</b> Core Practical                | <b>Hrs/Week:</b> 05                   |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 40 + Ext: 60 = 100 |

### Course Objectives:

- ❖ To get knowledge on isolation of auxotrophic mutants
- ❖ To estimate DNA and DNA
- ❖ To know the gene transfer mechanisms
- ❖ To produce citric acid
- ❖ To estimate the alcohol

1. Isolation of Auxotrophic mutants
2. Isolation of Chromosomal DNA from bacteria
3. Isolation of Plasmid DNA from bacteria
4. Isolation of Antibiotic resistance mutants by replica plating
5. Estimation of DNA – Diphenyl method
6. Estimation of RNA – Orcinol method
7. Separation of DNA/RNA using Agarose gel electrophoresis - Demonstration
8. Separation of Proteins using SDS – PAGE - Demonstration
9. Demonstration of Transformation, Conjugation and Transduction
10. Immobilization of yeast cell using sodium alginate.
11. Production of Citric acid using *Aspergillus niger*.
12. Alcohol fermentation by *Saccharomyces cerevisiae*
13. Estimation of Alcohol using Potassium di-chromate method
14. Starch (Amylase), Casein (Protease) and Lipid (Lipase) Hydrolyses test
15. Oyster mushroom cultivation.
16. Screening of antibiotics producing microbes.
17. Isolation of lactic acid producing bacteria from curd
18. Demonstration
  - a. Preparation of fermented food – Yoghurt and cheese

## b. Preparation of Wine

### References:

1. K.R.Aneja (2010). Experiments in Microbiology, Plant pathology and biotechnology. New Age International Pvt.Ltd.NewDelhi.
2. Cappuccino J.G. and N. Sherman 2002, Microbiology: A Laboratory Manual, Addison-Wesley.
3. Holt J.G, N.R.Krieg, 2000, Bergey's Manual of Determinative Bacteriology. Ninth edition, Lippincott Williams & Wilkin Publishers.
4. Kannan N, 2002, Laboratory Manual in General Microbiology, Panima Publishers.

### Course Outcomes:

After completion of this course, students would be able to

| Sl.No | Course Outcomes                          | Knowledge Level |
|-------|------------------------------------------|-----------------|
| CO1   | Explain the isolation of DNA             | K4              |
| CO2   | Isolate the antibiotic resistant mutants | K2              |
| CO3   | Know to produce wine from grapes         | K5              |
| CO4   | Determine the production of citric acid  | K5              |
| CO5   | Estimate the amount of alcohol           | K5              |

| Title of the Course: Major Practical - VI |                          |     |     |     |     | Course Code: U6R3MBCC14P           |       |       |       |       |                   |
|-------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                     | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                           | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO2                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO3                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO4                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
| CO5                                       | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 3     | 3.0               |
|                                           | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 3.0               |
|                                           | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## r-DNA TECHNOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBDSE7:1               | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective  | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25 + Ext: 75 = 100          |

### Course Objectives

- ❖ To educate the learners with the fundamental knowledge of recombinant DNA (rDNA) technology.
- ❖ To learn the enzymes of rDNA technology
- ❖ To describe the vectors used for cloning purpose
- ❖ To get knowledge on gene transfer techniques
- ❖ To study the hybridization techniques

### Unit I: Milestones in rDNA Technology

15 Hrs

Milestones in rDNA technology - Definition of gene manipulation - Major steps involved in gene cloning - Isolation and Purification of Chromosomal and Plasmid DNA, Isolation and Purification of RNA - Chemical Synthesis of DNA, Genomic Library and cDNA Library - applications.

### Unit II: Enzymes of rDNA Technology

15 Hrs

Restriction endonucleases: Discovery, Type I, II and III and Mode of action, Applications of type II restriction endonucleases, Ligases, DNA polymerases, DNA modifying enzymes and topoisomerases.

### Unit III: Cloning Vectors

15 Hrs

**Cloning vectors:** Definition and properties – Plasmid based vectors: Natural vectors (pSC101, pSF2124, pMB1), Artificial vectors (pBR322 and pUC) – Phage based vectors- λ) Lamda) phage vectors and its derivatives - Hybrid Vectors Phagemid and Cosmid, BAC and YAC – Expression systems – E. coli.

### Unit IV: Gene/ DNA Transfer Techniques

15 Hrs

Gene/ DNA transfer techniques: Physical – Biolistic Method (Gene gun), Electroporation, Microinjection. Chemical- Calcium chloride and DEAE Methods, Biological in vitro packaging method in viruses - Selection and Screening of recombinants: Direct Method: Selection by Complementation, Marker inactivation methods - Indirect methods: Immunological and Genetic methods.

**Unit V: Nucleic Acid and Protein Hybridization Techniques****15 Hrs**

Blotting (Southern, Western, Northern and North- eastern) techniques – PCR - basic steps in DNA amplification, RAPD, RFLP and their applications – DNA finger printing - DNA microarray analysis – Applications of recombinant DNA technology.

**Text Book**

1. Sambrook J, Fritsch E. R, Maniatis T, 1989, Molecular Cloning: A Laboratory Manual (2nd ed.). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Glover D. M, Hames B. D, 1995, DNA Cloning 1: A Practical Approach, RL Press, Oxford,
3. Chaudhuri K, 2013, Recombinant DNA Technology. India: Energy and Resources Institute.
4. Mahesh S, 2003, Biotechnology-4: Including Recombinant DNA Technology, Environmental Biotechnology, Animal Cell Culture. India: New Age International.
5. Satyanarayana U, 2014, Recombinant DNA and Biotechnology. India: Elsevier Health Sciences.

**Reference Books**

1. Sandhu S. S, 2013, Recombinant DNA Technology. India: I.K. International Publishing House Pvt. Limited.
2. Eun, H. 1996, Enzymology Primer for Recombinant DNA Technology. Ukraine: Elsevier Science.
3. Jain M, 2012, Recombinant DNA Techniques: A Textbook. United Kingdom: Alpha Science International.
4. Watson J. D, 1992. Recombinant DNA, United States: W. H. Freeman.
5. Brown, T. A, 2013, Gene Cloning and DNA Analysis: An Introduction. Germany: Wiley.

**Course Outcomes:**

After completion of this course, students would be able to

| Sl.No | Course Outcomes                                                               | Knowledge Level |
|-------|-------------------------------------------------------------------------------|-----------------|
| CO1   | Explain the basic techniques, and milestones of Genetic Engineering.          | K3              |
| CO2   | Understand the role of Enzymes in Gene manipulation.                          | K6              |
| CO3   | Recognize the relevance of the different kinds of vectors in rDNA technology. | K5              |
| CO4   | Acquire basic knowledge about isolation and purification of nucleic acids.    | K5              |
| CO5   | Describe the hybridization techniques                                         | K5              |

| Title of the Course: r-DNA Technology |                          |     |     |     |     | Course Code: U6R3MBDSE7:1          |       |       |       |       |                   |
|---------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                 | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                       | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                   | 3                        | 2   | 2   | 2   | 2   | 3                                  | 2     | 3     | 2     | 2     | 2.4               |
| CO2                                   | 3                        | 2   | 2   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.6               |
| CO3                                   | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO4                                   | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
| CO5                                   | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.8               |
|                                       | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.68              |
|                                       | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## MICROBIAL ECOLOGY

|                                                |                                                |
|------------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBDSE7:2               | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective  | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Skill Development | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To study the biotic and abiotic interactions.
- ❖ To be familiarized with the species diversity
- ❖ To know the functions of ecosystem.
- ❖ To understand the biodiversity.
- ❖ To get knowledge on environmental pollution

### Unit I: The Environment

15 Hrs

Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. Population Ecology: Characteristics of a population; population growth curves; population regulation

### Unit II: Community Ecology

15 Hrs

Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

### Unit III: Ecosystem Ecology

15 Hrs

Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); Food Chain, Food web, Trophic level, Ecological pyramids, primary production and decomposition; structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; biogeographical zones of India

### Unit IV: Biodiversity

15 Hrs

levels of biodiversity, alpha, beta and gamma diversity, hotspots of biodiversity, Threat to species diversity, Extinction vortex, Causes of extinction; RedData Book, Biodiversity conservation approaches: Local, National and International, In situ and ex situ conservation.

### Unit V: Applied Ecology

15 Hrs

Environmental pollution; Microorganisms and environmental pollutants, Overall process of biodegradation, Environmental biomonitoring and indicator microorganisms, biodegradation of organic pollutants.

### Text Books

1. Ronald M Atlas, Richard Bartha, 2008, Microbial Ecology: Fundamentals and applications. 4<sup>th</sup> Edition, Benjamin Cummings Publication.

2. Vijaya Ramesh K ,2007, Environmental Microbiology. 1<sup>st</sup> edition, MJP Publishers.
3. Joseph C Daniel,1999, Environment aspects of Microbiology. 1<sup>st</sup> edition, Bright sun Publications.
4. Sharma P.D, 2005, Environmental Microbiology, Narosa Publishing House (p) Ltd. New Delhi.
5. Subba Rao N.S, 2005,Soil Microbiology, 4<sup>th</sup> Edition, Oxford and IBH Publishing Co- Private Ltd, New Delhi.
6. Anuj Kumar Rana and Manoj Kumar Rana, 2015, Environment and Ecology, 2<sup>nd</sup> Edition,Global Academic Publishers & Distributors, New Delhi.

#### **Reference Books:**

- 1.Indu Shekhar Thakur 2006, Environmental Biotechnology ,Problems and Remedies. IK International Pvt. Ltd.
- 2.Rangaswami . G., Bagyaraj. D.J, 2004, Agricultural Microbiology, 2<sup>nd</sup> edition, Prentice Hall Private Ltd. New Delhi.
- 3.Mark Coyne, 2001,Soil Microbiology 1<sup>st</sup> edition, Thomson Asia (P) Ltd, Singapore.
- 4.Campbell R. 1983, Microbial Ecology. 2<sup>nd</sup> edition, Blackwell Scientific Publications, London.
- 5.Martin Alexander 1997,Introduction to Soil Microbiology. 2<sup>nd</sup> edition, John Wiley & Sons Publishers.
- 6.Mehrotra, R.S. and Ashok Aggarwal 2003,Plant Pathology. 2<sup>nd</sup> edition, Tata McGraw Hill Publishing Company Limited.
- 7.Ian L Pepper, Charles P Gerba, Terry J Gentry 2015, Environmental Microbiology. 3rd edition, Academic Press.

#### **Course Outcomes:**

**On completion of the course, students should be able to do**

| S.No. | Course Outcomes                                                         | Knowledge Level |
|-------|-------------------------------------------------------------------------|-----------------|
| CO1   | Predict the functions and diversity of microbes in natural environments | K2              |
| CO2   | Observe the various species of microbes                                 | K1              |
| CO3   | Develop a keen knowledge food chain and food web                        | K6              |
| CO4   | Explain the biodiversity                                                | K5              |
| CO5   | Determine the biodegradation                                            | K5              |

| <b>Title of the Course:</b> Microbial Ecology |                                 |            |            |            |            | <b>Course Code:</b> U6R3MBDSE7:2          |              |              |              |              |                          |
|-----------------------------------------------|---------------------------------|------------|------------|------------|------------|-------------------------------------------|--------------|--------------|--------------|--------------|--------------------------|
| <b>Course Outcomes (COs)</b>                  | <b>Programme Outcomes (POs)</b> |            |            |            |            | <b>Programme Specific Outcomes (PSOs)</b> |              |              |              |              | <b>Mean Score of COs</b> |
|                                               | <b>PO1</b>                      | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PS O1</b>                              | <b>PS O2</b> | <b>PS O3</b> | <b>PS O4</b> | <b>PS O5</b> |                          |
| <b>CO1</b>                                    | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO2</b>                                    | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO3</b>                                    | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO4</b>                                    | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
| <b>CO5</b>                                    | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 3            | 2            | 3            | 2.8                      |
|                                               | <b>Mean Overall Score</b>       |            |            |            |            |                                           |              |              |              |              | <b>2.8</b>               |
|                                               | <b>Result</b>                   |            |            |            |            |                                           |              |              |              |              | <b>High</b>              |

## VIROLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBDSE8:1              | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Employability    | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives

- ❖ To facilitate in understanding basics of viruses and their discovery.
- ❖ To impart the structure and classification of viruses.
- ❖ To teach about virus assay and diagnostics.
- ❖ To provide the fundamentals of bacteriophages.
- ❖ To understand the important features of plant viruses and common properties of human viruses.

### Unit – I: General Virology

15 Hrs

Virus – History of Virology - General properties of Viruses – Classification of Viruses (LHT, Baltimore and ICTV) - Ultra structure of Viruses – Sub viral agents viroids, prions, virusoids and satellite viruses – Replication of Viruses.

### Unit – II: Diagnostic Virology and Control of Viruses

15 Hrs

Cultivation of viruses- Embryonated eggs and Primary and secondary cell cultures. Serological methods- hemagglutination, hemagglutination inhibition, complement fixation, immunofluorescence, ELISA, RIA and assay of viruses. Purification, Characterization, Separation and Assay of Viruses. Viral Vaccines antiviral drugs, Interferons.

### Unit – III: Phages

15 Hrs

Bacteriophages - Classification - Structure and life cycle of T4 Phage, Lambda Phage and M13 Phage-lytic and lysogenic Life cycles - Bacteriophage typing - Cyanophages, Microphages and cultivation strategies of phages from sewage.

### Unit – IV: Human Viruses

15 Hrs

Classification - Structure, Multiplication, Pathogenesis, Diagnosis, Prevention and Treatment of following animal viruses – Polyomaviridae (Simian Virus – 40), Herpesviridae (HSV 1), Pox viridae (Small Pox), Hepadnaviridae (HBV), Picornaviridae (HAV), Rhabdoviridae (Rabies virus), Orthomyxoviridae (Influenza Virus), Retroviridae (Human Immuno Deficiency virus), Filoviridae (Ebola virus), Flaviviridae (Dengue Virus) and Coronaviridae (SARS-CoV2).

### Unit – V: Plant Viruses

15 Hrs

Classification– Transmission of plant viruses – Symptoms of Viral infection in plants - Control of plant viral diseases. Detailed study of TMV and CaMV. Common viral diseases in paddy, cotton, tomato and sugar cane - Name of diseases, pathogens and symptoms. Cultivation of Plant Viruses. Vector control.

### **Text Books:**

1. Warren Levinson., Peter Chin-Hong., Elizabeth A., Brian Schwartz, 2022, Review of Medical Microbiology and Immunology, 17<sup>th</sup> Edition, McGraw Hill Publishers, New Delhi.
2. Ellen Jo. Baron., Lance R. Peterson., Sydney M. Finegold. 1994, Bailey & Scott's Diagnostic Microbiology, 9<sup>th</sup> Edition, Mosby Publishers, Missouri.
3. Dubey R.C., Maheshwari D.K. 2021, A Textbook of Microbiology, 4<sup>th</sup> Edition, S. Chand Publishing, New Delhi
4. Jeffrey C and Pommerville. 2014, Alcamo's Fundamentals of Microbiology, Jones & Bartlett Student Edition, 10<sup>th</sup> Edition, Jones and Bartlett India Pvt, Ltd, New Delhi.
5. Ananthanarayan and Panikar's, 2023, Text book of Microbiology, 12<sup>th</sup> Edition, Universities Press (India) Private Ltd, Hyderabad.
6. Amitha Biswas. 2007, An Introduction to Viruses, Vikas Publishers, New Delhi.

### **Reference Books:**

1. Dimmock N.J. and Primrose S.B. 1994, Introduction to Modern Virology. IV edition, Blackwell Scientific Publications, Oxford.
2. Topley and Wilson's, 1990, Principles of Bacteriology, Virology and Immunity. 8<sup>th</sup> edition Vol. II Virology, Edward Arnold, London.
3. Ann Giudici Fetter. 1990, The Science of Viruses. Quill, William Marrow, New York.
4. Brown Publishers Patric R Murray, Medical Microbiology, 1990, Mosby Publications,
5. Nicklin, J. Greame Cook Killington, R, 2003, Instant Notes Microbiology. (2<sup>nd</sup> edition). Viva Books Private limited, New Delhi.
6. Roger Hull. 2002., Mathew's Plant Virology, 4<sup>th</sup> Edition. Academic Press-Harcourt Science and Technology Company, New York.
7. Conrat H.F, Kimball P.C. and Levy J.A. 1988. Virology. II edition. Prentice Hall, Englewood Cliffs, New Jersey.
8. Lansing M, Prescott, John P. Harley and Donald A. Klein. 2003, Microbiology, 5<sup>th</sup> edition, McGraw Hill, New York.
9. John Carter and Venetia Saunders. 2007, Virology Principles and Applications, John Wiley and Sons publishers.

**Course Outcomes:**

On completion of the course, students should be able to do

| S.No. | Course Outcomes                                                                             | Knowledge Level |
|-------|---------------------------------------------------------------------------------------------|-----------------|
| CO1   | Describe the classification of viruses                                                      | K2              |
| CO2   | Explain virus structure, process of virus attachment and entry, virus assembly and release. | K1              |
| CO3   | State the steps of viral replication .                                                      | K6              |
| CO4   | Understand the methods of preparing virus vaccines and anti-viral drugs                     | K5              |
| CO5   | Illustrate plant, animal and bacterial viruses                                              | K5              |

| Title of the Course: Diagnostic Microbiology |                          |     |     |     |     | Course Code: U6R3MBDSE8:1          |       |       |       |       |                   |
|----------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                        | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                              | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                          | 3                        | 3   | 2   | 3   | 3   | 3                                  | 1     | 1     | 1     | 1     | 2.1               |
| CO2                                          | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.8               |
| CO3                                          | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.7               |
| CO4                                          | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.7               |
| CO5                                          | 3                        | 3   | 2   | 3   | 3   | 3                                  | 3     | 2     | 3     | 2     | 2.7               |
|                                              | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.6               |
|                                              | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## PHARMACEUTICAL MICROBIOLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBDSE8:2              | <b>Credit:</b> 3                               |
| <b>Category:</b> Discipline Specific Elective | <b>Hrs/Week:</b> 05, <b>Total Inst.Hrs:</b> 75 |
| <b>Nature of the Course:</b> Employability    | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To gain knowledge on Chemotherapeutic agents
- ❖ To learn the antibiotic resistance
- ❖ To understand the microbial spoilage
- ❖ To familiarize with the Preservation of Pharma products
- ❖ To know the drug discovery

### Unit I: Introduction to chemotherapeutic agents

15 hrs

History and development of chemotherapeutic agent, Properties of antimicrobial agents, Types of chemotherapeutic agents – Synthetic, Semisynthetic, Natural. Antibiotics: Types of antibiotics with their mode of action; antibacterial, antifungal, antiviral, antiprotozoal

### Unit II: Antibiotic resistance and development of new therapeutics

15 hrs

Development of antibiotic resistance, Mechanism of antibiotic resistance, Antimicrobial Peptides: History, properties, sources, mode of action, application. Phage therapy: introduction to phages, lytic cycle, types of phages involved in phage therapy Plant based therapeutic agents.

### Unit III: Sterilization and Microbial spoilage of pharma products

15 hrs

Microbial contamination spoilage and hazard: Sources of contamination, factors affecting survival and growth, breakdown of active ingredient and general formulations. Principles of sterilizations with respect to pharmaceutical industries. Methods of sterilizations: Steam, dry heat, Radiation, Gaseous and Filtration.

### Unit IV: Preservation of Pharma Products: Principles of preservation

15 hrs

Objectives of preservation, the ideal preservative, rational development of a product preservative system etc. Antimicrobial preservatives and their properties: antimicrobial activity, factors affecting antimicrobial activity, preservative monographs. Preservative stability and efficacy. methods of Preservative evaluation and testing.

## **Unit V: Drug Discovery and Development**

**15 hrs**

Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies. Conventional Process; Bio-prospecting. Search of database/data mining for Drug designing; Preclinical and Clinical trials; Estimation of toxicity: LD50 and ED50; Rational Drug Design – Principle (Structure activity relationship -SAR) and Tools (applications of High through Put Screening, Combinatorial synthesis, Pharmaco-genomics).

### **Text Books:**

1. Manoj Kumar, 2010, Pharmaceutical Microbiology, 1<sup>st</sup> Edition, Anmol Publications Pvt, Ltd, New Delhi.
2. Ramakrishnan S, Prasannan K.G, Rajan R, 2001, Textbook of Medical Biotechnology, 3<sup>rd</sup> Edition, Orient Longman Pvt. Ltd. Hyderabad, India.
3. Chatterjea M.N., Rana Shinde, 2013, Textbook of Medical Biochemistry, 8<sup>th</sup> Edition, Jaypee Brothers Medical Publishers Pvt. Ltd. New Delhi.
4. Bhagvan N.V., 2004, Medical Biochemistry, 4<sup>th</sup> Edition, Academic Press, USA
5. Jogdand S.N, 2008, Pharmaceutical Microbiology, 1<sup>st</sup> Edition, Himalaya Publishing House, Bangalore.
6. Patricia Stone., Stephen J. Curtis, 2008, Pharmacy Practice, 3<sup>rd</sup> Edition, Viva Books, chennai.

### **Reference Books:**

1. Hugo, WB and Russell, AD. Pharmaceutical Microbiology, 2003, Blackwell Science, Oxford, UK.
2. Krogsgaard L, Lilijefors T. and Madsen, U2004, Textbook of Drug Design and Discovery, Taylor and Francis, London.
3. Geoffrey Hanlon and Norman Hodges, 2013, Essential Microbiology for Pharmacy and Pharmaceutical science. Wiley Blackwell.
4. Viyas S. P. & Dixit.V. K. 2003, Pharmaceutical Biotechnology. CBS Publishers & Distributors, New Delhi.
5. Bhatia R and Ichhpujani RL. Quality Assurance in Microbiology. 1995, CBS Publishers, New Delhi.
6. Gregory Gregoriadis, 2001, Drug Carriers in biology & Medicine. Academic Press New York.
7. Davis, B. D., Dulbecco, R, Eisen, H. N., Ginsberg, R. S., 1990, Microbiology. Harper and Row Publishers, Singapore.

**Course Outcomes:**

After completion of this course, students would be able to

| S.No | Course outcome                                                   | Knowledge level |
|------|------------------------------------------------------------------|-----------------|
| CO1  | Explain the chemotherapeutic agents                              | K2              |
| CO2  | Identify different antimicrobial agents and its mode of action.  | K3              |
| CO3  | Summarize the microbial spoilage of pharma products              | K3              |
| CO4  | Apply the regulatory guidelines in pharmaceuticals product.      | K3              |
| CO5  | Determine the process involved in Drug discovery and development | K5              |

| Title of the Course: Pharmaceutical Microbiology |                          |     |     |     |     | Course Code: U6R3MBDSE8:2          |       |       |       |       |                   |
|--------------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                            | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                                  | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO2                                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO3                                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO4                                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 2     | 2.8               |
| CO5                                              | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 3     | 2     | 2.9               |
|                                                  | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.82              |
|                                                  | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## MUSHROOM TECHNOLOGY

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBSEC7:1              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- ❖ To learn the basics of mushrooms in human food
- ❖ To know mushroom propagation for food industries
- ❖ To give an opportunity for future entrepreneurship
- ❖ To get knowledge on mushroom cultivation
- ❖ To get idea on nutrition availability in mushroom

### Unit I: Introduction

6 hrs

Introduction - History - Classification and distribution of mushrooms- Life cycle- Common edible mushroom in India (*Calocybe indica*, *Volvariella volvacea*, *Pleurotus sajor-caju* and *Agaricus bisporus*), Research centers: International level, National level and Regional level..

### Unit II: Pure Culture and Spawn Preparation

6 hrs

Collection- Isolation of pure culture - preparation of nutrient media (PDA and Oatmeal agar media) - sterilization - Preparation of test tube slants to store mother culture - culturing of *Pleurotus* mycelium on petriplates - Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

### Unit III: Cultivation Technology

6 hrs

Layout of mushroom shed- small scale and large scale, Types of raw materials (substrates) - preparation and sterilization, Mushroom bed preparation - Paddy straw, sugarcane trash, maize straw, banana leaves - maintenance of mushroom shed - harvesting method - storage and preservation of mushrooms.

### Unit IV: Storage and Nutrition

6 hrs

Storage and nutrition: Short term storage - long term storage (scanning, pickles, papads, drying, and storage in salt solutions) - Nutrition: Proteins, amino acids, mineral elements. Nutrition: Carbohydrates - Crude fiber content, vitamins.

### Unit V: Food Preparation and Economic Importance

6 hrs

Types of foods prepared from mushroom - soup, cutlet, omlette, samosa, pickles and curry. Economics of mushroom cultivation: Fixed assets, recurring expenditure, labour, economics of cultivation throughout the year, Cost benefit ratio: Marketing in India and abroad – Export value.

**Text Books:**

1. Marimuthuet al., 1991,Oyster Mushrooms, Dept. of Plant Pathology, TNAU, Coimbatore.
2. Tewan and Pankaj Kapoor S.C. 1993, Mushroom cultivation. Mittal Publication. Delhi.
3. Swaminathan M. 1990, Food and Nutrition. Bappco. The Bangalore Pritning and Publishing Company Ltd., Bangalore.
4. Singh, Reeti and Singh, V.C. 2005, Modern Mushroom Cultivation. Agrobios, India.
5. Rajan S, 2020, Mushroom Technology, Second Edition, CBS Publishers, New Delhi.

**Reference Books**

1. Gogoi, R., Rathaiah, Y. and Borah, T.R., 2019,Mushroom cultivation technology. Scientific Publishers.
2. Petre, M., 2015,Mushroom biotechnology: developments and applications. Academic Press.
3. Suman, B.C. and Sharma, V.P., 2007, Mushroom cultivation in India. Daya Books.
4. Zied, D.C. and Pardo-Giménez, A. eds., 2017, Edible and medicinal mushrooms: technology and applications. John Wiley & Sons.
5. Bertelsen, C.D., 2013,Mushroom: A global history. Reaktion Books.
6. Rajan S, 2020, Mushroom Technology, Second Edition, CBS Publishers, New Delhi.

**Course Outcomes**

After completion of this course, students would be able to

| S.No. | Course Outcomes                                                          | Knowledge Level |
|-------|--------------------------------------------------------------------------|-----------------|
| CO1   | Discuss the characteristics of mushroom and scope of Mushroom technology | K2              |
| CO2   | Find the pure culture and spawn production of Mushroom                   | K5              |
| CO3   | Determine the different Cultivation methods                              | K3              |
| CO4   | Describe the storage and maintain the nutritional value                  | K2              |
| CO5   | Manipulate the food Products from mushrooms                              | K5              |

| Title of the Course: Mushroom Technology |                          |     |     |     |     | Course Code: U6R3MBSEC7:1          |       |       |       |       |                   |
|------------------------------------------|--------------------------|-----|-----|-----|-----|------------------------------------|-------|-------|-------|-------|-------------------|
| Course Outcomes (COs)                    | Programme Outcomes (POs) |     |     |     |     | Programme Specific Outcomes (PSOs) |       |       |       |       | Mean Score of COs |
|                                          | PO1                      | PO2 | PO3 | PO4 | PO5 | PS O1                              | PS O2 | PS O3 | PS O4 | PS O5 |                   |
| CO1                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO2                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO3                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO4                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
| CO5                                      | 3                        | 3   | 3   | 3   | 3   | 3                                  | 3     | 3     | 2     | 3     | 2.9               |
|                                          | Mean Overall Score       |     |     |     |     |                                    |       |       |       |       | 2.9               |
|                                          | Result                   |     |     |     |     |                                    |       |       |       |       | High              |

## GOOD LABORATORY PRACTICES

|                                               |                                                |
|-----------------------------------------------|------------------------------------------------|
| <b>Course Code:</b> U6R3MBSEC7:2              | <b>Credit:</b> 2                               |
| <b>Category:</b> Skill Enhancement Course     | <b>Hrs/Week:</b> 02, <b>Total Inst.Hrs:</b> 30 |
| <b>Nature of the Course:</b> Entrepreneurship | <b>Marks:</b> CIA: 25+ Ext: 75 = 100           |

### Course Objectives:

- To Prepare students for practical study in life science laboratories.
- To handle safely every laboratory facility and know troubleshoot measures during laboratory processes.
- To maintain the laboratory
- To keep, analyse laboratory data with accuracy.
- To Errors related with handling of laboratory material and work becomes more accurate and precise.

### Unit I: Quality Control

6 hrs

Internal and external Assessment, Quality improvement, Total Quality Control Programme. Quality Assurance – Attributes, Immunization programme

### Unit II: Internal Quality Control

6 hrs

Clinical Microbiology Laboratories- Standard operating procedure manuals, Specimens- Equipments – Biosafety cabinets, Media, Tests\_ Biochemical, Staining, Antimicrobial Susceptibility, Serological Biological Production units

### Unit III: External Quality Assessment

6 hrs

EQA-Types-Requirement of EQA programme. Organization of EQA, Scoring System in EQA, National External Quality Control assessment.

### Unit IV: Good manufacturing practices

6 hrs

Quality Control Factors influencing GMP- Production and documentation- Principles of production and quality control of biologicals.

### Unit V: Quality Control

6 hrs

Analytical Validation Overview of Quality Assurance- Objectives & Components, Need for Quality Assurance & its benefits. Quality Management-Quality System, Quality plan.

## Text Books

1. Rajesh K, 2005, Clinical Microbiology, Jaypee Brothers Medical Publishers (P) Ltd.
2. Nagoba, B.S, 2009, Clinical Microbiology, B.I. Publications Pvt. Ltd
3. Seiler, J. P, 2012, Good Laboratory Practice: The Why and the How. Germany: Springer Berlin Heidelberg.
4. Hirsch, A.F, 1989, Good Laboratory Practice Regulations. Switzerland: M. Dekker.
5. Guidelines for good laboratory practices, 2008, Indian council of medical research, New Delhi.

## Reference Books

1. Ahmed Badr Eldin, 2011, Modern Approaches to Quality Control. Croatia: IntechOpen.
2. Nigel Dent, Nigel J. Dent, Philip Carson, Phillip A. Carson, 2007, Good Clinical, Laboratory and Manufacturing Practices: Techniques for the QA Professional. United Kingdom: Royal Society of Chemistry.
3. Allport-Settle, M. J, 2010, Good Laboratory Practice: Nonclinical Laboratory Studies Concise Reference. (n.p.): Pharmalogika.
4. Elzagheid, M, 2023, Chemical Technicians: Good Laboratory Practice and Laboratory Information Management Systems. Germany: De Gruyter.
5. Graham P. B, 2022, Good Laboratory Practice for Nonclinical Studies. United States: CRC Press.

## Course Outcomes

After completion of this course, students would be able to

| S.No. | Course Outcomes                                                                                       | Knowledge Level |
|-------|-------------------------------------------------------------------------------------------------------|-----------------|
| CO1   | Define the fundamentals of GLP                                                                        | K1              |
| CO2   | Illustrate the safely practice in basic laboratory procedures and protocols in future lab situations. | K2              |
| CO3   | Apply the procedures in lab maintenance                                                               | K3              |
| CO4   | Inspect the non-instrumental basic laboratory techniques                                              | K4              |
| CO5   | Determine the instrumental basic laboratory techniques                                                | K5              |

| <b>Title of the Course:</b> Good Laboratory Practices |                                 |            |            |            |            | <b>Course Code:</b> U6R3MBSEC7:2          |              |              |              |              |                          |
|-------------------------------------------------------|---------------------------------|------------|------------|------------|------------|-------------------------------------------|--------------|--------------|--------------|--------------|--------------------------|
| <b>Course Outcomes (COs)</b>                          | <b>Programme Outcomes (POs)</b> |            |            |            |            | <b>Programme Specific Outcomes (PSOs)</b> |              |              |              |              | <b>Mean Score of COs</b> |
|                                                       | <b>PO1</b>                      | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PS O1</b>                              | <b>PS O2</b> | <b>PS O3</b> | <b>PS O4</b> | <b>PS O5</b> |                          |
| <b>CO1</b>                                            | 3                               | 3          | 2          | 3          | 3          | 3                                         | 1            | 1            | 1            | 1            | 2.1                      |
| <b>CO2</b>                                            | 3                               | 3          | 3          | 3          | 3          | 3                                         | 3            | 2            | 3            | 2            | 2.8                      |
| <b>CO3</b>                                            | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 2            | 3            | 2            | 2.7                      |
| <b>CO4</b>                                            | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 2            | 3            | 2            | 2.7                      |
| <b>CO5</b>                                            | 3                               | 3          | 2          | 3          | 3          | 3                                         | 3            | 2            | 3            | 2            | 2.7                      |
|                                                       | <b>Mean Overall Score</b>       |            |            |            |            |                                           |              |              |              |              | <b>2.6</b>               |
|                                                       | <b>Result</b>                   |            |            |            |            |                                           |              |              |              |              | <b>High</b>              |