

**ST.MARY'S COLLEGE (AUTONOMOUS), THOOTHUKUDI**  
**Master of Science (Microbiology)**  
**Course Structure (w.e.f 2017-18)**  
**SEMESTER-I**

SUBJECT	Subject code	Title of the paper	Contact hours/ week	Credit	Max. marks		
					CIA	ESE	Total
CORE-I	17PMIC11	Fundamentals of Microbiology	6	5	40	60	100
CORE-II	17PMIC12	Microbial Diversity and Classification	6	5	40	60	100
CORE-III	17PMIC13	Microbial Physiology	6	5	40	60	100
ELECTIVE-I	17PMIE11	Computers And Biostatistics	6	5	40	60	100
PRACTICAL -I	17PMICR1	Laboratory in Fundamentals of Microbiology, Microbial diversity and Microbial Physiology	6	3	40	60	100
			30	23	200	300	500

**SEMESTER-II**

SUBJECT	Subject code	Title of the paper	Contact hours/ week	Credit	Max. marks		
					CIA	ESE	Total
CORE-IV	17PMIC21	Biochemistry	6	5	40	60	100
CORE-V	17PMIC22	Immunology	6	5	40	60	100
CORE-VI	17PMIC23	Medical Microbiology	6	5	40	60	100
ELECTIVE-II	17PMIE21	Rural Biotechnology/Vermi Technology /Mushroom Technology	6	4	40	60	100
PRACTICAL-II	17PMICR2	Techniques in Biochemistry, Immunology an Medical Microbiology	6	3	40	60	100
SELF STUDY COURSE (Compulsory)	17PMISS1	Quality Assurance Techniques in Sea food Processing industry		+2			100
			30	22+2	200	300	600

**SEMESTER-III**

SUBJECT	Subject code	Title of the paper	Contact hours/ week	Credit	Max. marks		
					CIA	ESE	Total
CORE-VII	17PMIC31	Agricultural and Environmental Microbiology	6	5	40	60	100
CORE-VIII	17PMIC32	Research Methodology	6	5	40	60	100
CORE-IX	17PMIC33	Industrial and Pharmaceutical Microbiology	6	5	40	60	100
PROJECT	17PMIP31	Research Project	6	5	40	60	100
PRACTICAL-III	17PMICR3	Techniques in Agricultural, Environmental, Industrial and Pharmaceutical Microbiology	6	3	40	60	100
SELF STUDY COURSE (OPTIONAL)	17PMISS2	PROBIOTICS		+2			100
			30	23+2	200	300	500+100

**SEMESTER-IV**

SUBJECT	Subject code	Title of the paper	Contact hours/ week	Credit	Max. Marks		
					CIA	ESE	Total
CORE-X	17PBCC41	Marine Biology	6	5	40	60	100
CORE-XI	17PMIC42	Microbial Genetics and Molecular Biology	6	5	40	60	100
CORE-XII	17PMIC43	Food Microbiology	6	5	40	60	100
ELECTIVE-III	17PMIE41	Genetic Engineering	6	4	40	60	100
PRACTICAL -IV	17PMICR4	Techniques In Microbial Genetics, Molecular Biology, Food Microbiology And Genetic Engineering	4	2	20	30	50
PRACTICAL -V	17PBCCR1	17PBCC41	2	1	20	30	50
			30	22	200	300	500

<b>SEMESTER - I</b>			
<b>CORE – I FUNDAMENTALS OF MICROBIOLOGY</b>			
<b>Code : 17PMIC11</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credit: 5</b>

## **OBJECTIVES**

1. To impart advanced level information in the subject of General Microbiology
2. To enhance the students with the basic knowledge on various techniques.

## **UNIT I**

Evolution of Microbiology – Contributions of Van Leeuwenhoek, Joseph Lister, Louis Pasteur, Robert Koch, Edward Jenner, Winogradsky and Beijerinck – Further developments in Microbiology – identification, characterization and classification of microorganisms – Distinguishing characteristics between prokaryotic and eukaryotic cells – Phenotypic characters – Taxonomic characters – Distinctive characters of major groups of microorganisms – Principles of classification .

## **UNIT II**

Microscopy – It's principles and applications in the field of microbiology including the following; Dark field, phase contrast, fluorescence microscopy, transmission and scanning electron microscopy, confocal microscopy – colorimeter, spectrophotometer and lyophilizers – Staining methods- Gram's acid – fast, met-achromatic granules, nuclear, capsule, flagella, silver impregnation and Giemsa staining methods.

## **UNIT III**

Methods of sterilization: Physical and chemical agents, radiation and filtration – Indicator microorganisms for sterilization methods- Cultivation of microorganisms – Microbiological media, enrichment media, enriched media, transport media, selective media and pure culture technique – Methods of preservation and maintenance of cultures – Role of disinfectants.

## **UNIT IV**

Bacterial anatomy, structure, properties and bio – synthesis of cellular components of bacteria – Sporulation and it's mechanism – Growth and nutrition – Nutritional requirements – Autotrophs – Heterotrophs – Enrichment cultures – Growth curve – Kinetics of growth – Batch culture – Synchronous growth – Measurement of growth and enumeration of cells – Techniques of pure culture.

## **UNIT V**

Microbe-Human interaction: infection and disease- Resident flora- pathogenicity and virulence. Varied pattern of infection-epidemiology- infectious diseases-recognition of an infectious disease in a population- recognition of an epidemic- the infectious disease cycle-study of disease- virulence and the mode of transmission- the emergence of new disease-control of epidemics.

### **Text Book Recommended:**

1. Prescott L.M. Harley J.P. and Klein D.A (2008). Microbiology (7<sup>th</sup> Edition) McGraw Hill, New York.

2. Madigan M., T., Martinko. J.M., and Parker J., Brock TD. (1997) Biology of Microorganisms. (8<sup>th</sup> Edition). Prentice Hall International Inc, London.
3. Salle, A.J. (1996). Fundamental Principles of Bacteriology. (7<sup>th</sup> Edition) Tata McGraw – Hill Publishing Company Ltd, New Delhi.
4. Pelzar Jr., M.J.Chan E.C.S., and Kreig N.R. (1993). Microbiology – McGraw Hill, Inc., New York.
5. Stainer R.Y., Ingraham J.L., Wheelis M.L., and Painter P.R. (1986) General Microbiology, Mac Millan Education Ltd., London.
6. Tortora, Funke, Case Addison 2001, Microbiology – An Introduction – 7<sup>th</sup> Edition, Wesley Longman Inc.
7. Dubey R.C., and Maheswari,S. 2003 A Text Book of Microbiology. S. Chand & Co, New Delhi.
8. Talaro K.P., and Talaro.A. (1999). Foundations in Microbiology. WCP McGraw – Hill, New York.
9. Marimuthu. R. (2008). Microscopy and Micro technique Publishers.
10. Dubey and Maheshwari. (2006). A text book of Biotechnology. Chand publications
11. David friefelder (1982). Microbial Genetics. Narosa publishing house

SEMESTER – I			
CORE – II - MICROBIAL DIVERSITY AND CLASSIFICATION			
Code:17PMIC12	Hrs/ Week: 6	Hrs/ Sem: 90	Credit: 5

## OBJECTIVES

1. To impart advanced level information in the subject of Microbial Diversity
2. To give the students information about the various groups of microorganisms.

## UNIT I

Classification of microorganisms – Introduction – Haeckel's three kingdom concept – Whittaker' five kingdom concept – Three domain concept of Carl Woese basis of microbial classification, Salient features of bacteria according to Bergey's manual of determinative bacteriology – Cyanobacteria – Archaeobacteria evolution of archaeobacterial membranes, cell wall and metabolism).

## UNIT II

Fungi: Historical introduction ,Morphology, taxonomy and classification, structure and cell differentiation of *Aspergillus sp*, *Candida sp*, *Mucor sp*, *Agaricus sp*. Mycorrhiza – Ectomycorrhizae, Endomycorrhizae, Vesicular Arbuscular Mycorrhizae

## UNIT III:

Algae: Distribution, general characters, thallus and its structure, classification, nutrition and reproduction – Characters of selected groups – Blue green algae, Dianoflagellates, Euglenophyta, Chrysophyta, Phaeophyta and Rhodophyta – Economic importance of algal biotechnology.

## UNIT IV:

Virus : Classification, nomenclature and properties. Structure and characteristic of T4, Adeno virus, HIV, Rabdo virus, CaMV and TMV. Brief outline on virion and Prions.

## UNIT V:

Protozoa : Distinguishing characters, classification, host-parasite relationship, pathogenic mechanism, transmission, life cycle, lab diagnosis, treatment for the following:

*Entamoeba sp*, *Leishmania sp*, *Giardia sp* and *Trichomonas sp*. Helminthes: Classification, lifecycle, pathogenesis, transmission, lab diagnosis treatment for Cestodes (*Taenia solium*) – Nematodes (*Ascaris lumbricoides*,) – Arthropod vectors: Tick and mosquitoes– Biology, life cycle and transmission diseases to human.

## REFERENCES:

1. Prescott L.M., Harley J.P., and Klein D.A (2008). Microbiology (7<sup>th</sup> Edition) McGraw Hill, New York.
2. Madigan M.T., Martinko. J.M.Parker J., and Brock T.D. (1997). Biology of Microorganisms. (8<sup>th</sup> Edition). Prentice Hall International Inc, London.
3. Salle, A.J. (1996). Fundamental Principles of Bacteriology (7<sup>th</sup> Edition). Tata McGraw-Hill Publishing Company Ltd., New Delhi.

4. Alexopoulos, C.J., and Mims, C.W. (1979). *Introductory Mycology*, Wiley, New York.
5. Pelczar Jr. M.J., Chan E.C.S., and Kreig N.R. (1993). *Microbiology – McGraw Hill, Inc.*, New York.
6. Stainer R.Y., In graham J.L., wheelis M.L., and Painter P.R. (1986). *General Microbiology*, Macmillan Education Lt., London.
7. Starr, M.P., Stolp, H., Truper, H.C. Balows, A., and Schlegel, H.C. (1991). *The Prokaryotes. A Hand Book of Habitats, Isolation and Identification of Bacteria*. Springer Verlag.
8. Tortora, Funke, and Case Addison (2001). *Microbiology - An Introduction – 7<sup>th</sup> Edition* Wesley Longman Inc
9. Dubey. R.C., and Maheswari, S. (2003). *A Text Book of Microbiology – Chand & Co*, New Delhi.
10. John L. Ingraham and Catherine A. Ingrahani 2000, *Introduction to Microbiology*. Books/Cole Thompson Learning, UK.
11. Talaro. K.P. and A. Talaro. (1999). *Foundations in Microbiology*. WCP McGraw-Hill, New York.
12. Jagadish Chandar (1996). *A Text Book of Medical Mycology*. Inter Print. New Delhi.
13. Stryer L. (1995). *Biochemistry* W.H. Freeman and Company, New York.

<b>SEMESTER – I</b>			
<b>CORE – III MICROBIAL PHYSIOLOGY</b>			
<b>Code: 17PMIC13</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credit: 5</b>

### **OBJECTIVES**

To give the students knowledge about the physiological processes of microorganisms.

#### **UNIT I:**

Definition, terminology – types - specific functions and general pattern of metabolism-anabolism versus catabolism - metabolic pathways - linear, irreversible and branched metabolic pathways – Chemiosmotic theory. Substrate level phosphorylation, Oxidative phosphorylation- Electron transport chain- the components of electron transport chain - NAD, NADP, FAD, FMN, Coenzyme Q, Cytochromes, Ferredoxin and Iron Sulphur protein- Role of ATP in metabolism.

#### **UNIT II:**

Microbial growth- Growth curve of bacteria- Measurement of cell growth- Bacterial Transport mechanisms – Secretion systems in bacteria- (Type I, II, III & IV)

#### **UNIT III:**

Electron transport under anaerobic conditions-nitrate respiration, sulphate respiration, sulphur respiration, carbonate respiration , fumarate respiration and iron respiration. Aerobic respiration-glycolysis-TCA cycle, gluconeogenesis and Calvin-Benson cycle.

#### **UNIT IV:**

Outline mechanisms and ATP regeneration by fermentation- alcoholic fermentation by yeasts and bacteria- ethanol formation. Lactic acid fermentation- homo-fermentation, hetero-fermentation - propionic acid fermentation-formic acid fermentation – butyric acid- butanol fermentation-homo acetate fermentation.

#### **UNIT V:**

Aerobic and anaerobic phototropic bacteria-purple sulphur, non-sulphur purple bacteria, green sulphur bacteria and Cyanobacteria-pigments of the photosynthetic apparatus- bacterio-chlorophylls, carotenoids and bacterio rhodopsin- localization of the pigments-regulation of pigments. Anoxygenic photosynthesis-Oxygenic photosynthesis - photosynthesis in halobacteria. Bioluminescence.

#### **Reference Books:**

1. Santhyanarayana. U 2002. Essentials of Biochemistry. (1<sup>st</sup> Edition) Books and Allied (P) Ltd., Kolkata ,
2. A.C.Deb 1999. Concepts of Biochemistry. (7<sup>st</sup> Education), Books and Allied (P)Ltd.,Kolkata
3. Prescott, Lansing M, Harley, JohnP,Klein Donald A,1999,Microbiology McGraw-Hill, New York,
4. Principle of Biochemistry. Lehninger. 3<sup>rd</sup> editions by Nelson and Cox (Worth) 200.
5. Biochemistry Stryer 5<sup>th</sup> education W.H. Freeman 2001

<b>SEMESTER – I</b>			
<b>ELECTIVE – I</b>			
<b>COMPUTERS AND BIOSTATISTICS</b>			
<b>Code:17PMIE11</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credit: 5</b>

**OBJECTIVES:**

1. To inculcate knowledge on the basics of computers.
2. To furnish the students with the knowledge of biostatistics.

**UNIT I**

Introduction to Computers : Classification of computers – personal, mini, main frame and super computers, their characteristics and application, Computer generation, Compilers and Interpreters, BIT, BYTE, WORD, Computer memory and its types, Data representation and storage.

**UNIT II**

Hardware and software: Input, output, and secondary storage devices, central processing unit; types of software; meaning, functions and types of operating system; computer languages. Understanding computer networks: LAN, WAN and MAN -Types of topologies - Transmission media.

**UNIT III**

Working with software packages: An introduction to PC-software packages; MS Word-working with text, tables, checking spelling and grammar, printing a document; MS Excel-working with worksheet, formulas and functions, inserting charts; MS Powerpoint presentation-working with different views and designing presentation.

**UNIT IV**

Introduction, population and samples – variables- collection of Data- Classification and tabulation of data- Diagrams and graphs-Measures of central tendency & Dispersion.

**UNIT V**

Hypothesis testing, Test of hypothesis involving one sample – Test of hypothesis involving two samples – The analysis of variance. Excel software- SPSS, STATA.

**Reference Books:**

- 1.How computers work, 2000 Ron White, Techmedia.
- 2.How the internet works 2000, Preston GrallaTechmedia.
- 3.Alexis leon& Mathews leon:Introduction to computers 2008, McGraw-Hill.
- 4.B.L. Juneja&A.Seth; Computer fundamentals &C Programming 2012 Cengage Learning India
- 5.Thomas Glover, Kevin Mitchell; An Introduction to Biostatistics 2002 bythe McGraw Hill.
- 6.Steve Selvin Biostatistics How it works 2004 by Pearson education.
7. Dr.N.Gurumani; An Introduction to biostatistics 2005 by MJP publisher
8. Arora P.N. Malhan P.K. Biostatistics, Delhi: Himalaya Publishing House, 1996.
- Gupta C.B. An introduction to statistical methods New delhi; Vikas Publishers, 1992.
9. Palanichamy S. and ManoharanM.Statistical methods for biologists.



Casella G. and Berger R. L., Statistical Inference (The Wadsworth and Brooks / Cole Statistics / Probability Series), Brooks / Cole Pub Company.

10. Spiegel M. R., Schiller J.J., Srinivasan R. A. , A. Srinivasan Schaum's Outline of Probability and Statistics. McGraw-Hill Trade.

11. B. Thigarajan & PA Rajalakshmi; Computational biology 2009.

<b>SEMESTER – I</b>			
<b>PRACTICAL – I</b>			
<b>LABORATORY IN FUNDAMENTALS OF MICROBIOLOGY, MICROBIAL DIVERSITY AND MICROBIAL PHYSIOLOGY</b>			
<b>Code: 17PMICR1</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credit: 3</b>

## **OBJECTIVES**

To make the students imbibe the technical knowledge in the field of General Microbiology, Microbial diversity and Bio instrumentation.

1. a) Laboratory Precautions
  - b) Washing and cleaning of glass wares
  - c) Biological safety cabinets
2. a) Hay mount to show different types of microbes
- b) Hanging drop technique
3. Staining techniques - Gram's staining, Acid fast staining, Spore staining, Capsule staining
4. a) Preparation of culture media for micro organisms.
- b) Techniques for pure culture of microorganisms by Serial dilution technique and determination of bacterial numbers.
  - i) Pour plate method.
  - ii) Streak plate method.
  - iii) Spread plate method.
  - iv) Enumeration of bacteria – Water and soil samples
  - v) Microbial sampling of air
  - vi) Cultivation of anaerobic microorganisms – Pyrogallol method.
5. a) Cultural characteristics of microorganisms.
  - b) Generic identification of unknown bacterial cultures.
  - c) Generic identification of an unknown fungi.
  - d) Isolation of Bacteriophage from sewage.
  - e) Isolation of Protozoa from soil.
  - f) Isolation of VAM spores from soil.
  - g) Isolation of yeast from grapes.

6. Extra cellular enzymatic activities of microorganisms (Utilization of gelatin, casein, starch, lipid)
7. Carbohydrate fermentation (Glucose, Lactose, Sucrose)
8. Triple sugar iron test
9. IMViC test series
10. H<sub>2</sub>S test
11. Urease test
12. Catalase test
13. Growth curve (Turbidity method)
14. Cultivation and morphology of molds – Lacto phenol cotton blue staining
15. Fungal slide culture – technique
16. Examination of dry weight of bacteria

#### **References:**

1. Cappuccino.J.G., and Sherman.N.(1996). Microbiology – A Laboratory Manual. Benjamin Cummins. New York.
2. Kannan.N. (1995). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
3. Gunasekaran. P. (1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
4. Sundararaj, T. (2005), Microbiology – Laboratory Manual. (First Edition) Publ. Sundararaj. T, Chennai.
5. Jayaraman, J. (1985). Laboratory Manual in Biochemistry. Wiley Eastern Ltd., New Delhi.
6. Palanivelu. P. Analytical Biochemistry and Separation Techniques.
7. Rajan.S.,Selvi Christy. R (2012).Experimental procedure in Life sciences. Anjanaa Book House.
8. Aneja.K.R., Experiments in Microbiology, Plant pathology and Biotechnology. Fourth Revised Edition. New Age International Publishers.

<b>SEMESTER – II</b>			
<b>CORE – IV BIOCHEMISTRY</b>			
<b>Code : 17PMIC21</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credits: 5</b>

### **OBJECTIVES**

1. To give the students knowledge about the biochemical processes of microorganisms.
2. To provide knowledge about various biochemical concepts.

### **UNIT I**

Carbohydrates- definition and classification- properties- optical and chemical structure of glucose, ring structure, Haworth and Fischer's projection, pyranose, furanose isomers, mutarotation, triose, pentose, hexose, heptose,- examples and structures, derived monosaccharide, glycosides, furanoacids, sugar, phosphates, uronic acids, sugar alcohol, disaccharides, glycosidic linkage, lactose, maltose, sucrose, oligosaccharide, trisaccharides, structure of raffinose- polysaccharide- homopolysaccharide, heteropolysaccharide structure, starch, cellulose, mucopolysaccharide, and biological significance.

### **UNIT II**

Lipids- classification, chemistry of fatty acids- unsaturated, saturated fatty acids, triglycerides, saponification, sterols, cholesterol, prostaglandins, glycolipids and function of lipids.

### **UNIT III**

Proteins- classification, structure of primary, secondary, tertiary and quaternary protein, classification of amino acids, properties, peptide bond, formation and types

### **UNIT IV**

Nucleic acid- structure of nitrogen bases and base pairing, structure of nucleosides, nucleotides, ribose, deoxyribose sugar. DNA, RNA structure, function, types and importance.

### **UNIT V**

Enzymes- concept, definition, nature, active site, properties, classification, physico-chemical properties. Factors affecting the enzyme synthesis and activity. Allosterism – Determination of Michaelis-Menten constant – Factors affecting Km Value – Mode of Enzyme action (Lock and Key model and Induced fit model)- coenzymes – Cofactors – Isozymes and Inhibitors.

### **Reference Books:**

1. Stryer, L. 1995. Biochemistry. Ed. W. H. Freeman and company, New York.
2. Fundamental of Biochemistry- J. L. Jain, S. Chand & company Ltd, New Delhi.
3. Santhyanarayana. U 2002. Essentials of Biochemistry. (1<sup>st</sup> Edition) Books and Allied Ltd., Kolkata ,
4. A. C. Deb 1999. Concepts of Biochemistry. (7<sup>th</sup> Edition), Books and Allied (P) Ltd., Kolkata
5. Hubert, Stryer, 1995. Biochemistry – Freeman and Company, New York.
6. Principle of Biochemistry. Lehninger. 3<sup>rd</sup> editions by Nelson and Cox (Worth) 2009.

<b>SEMESTER - II</b>			
<b>CORE – V</b>			
<b>IMMUNOLOGY</b>			
<b>Code : 17PMIC22</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 90</b>	<b>Credits: 5</b>

### **OBJECTIVE**

1. To impart advanced level information in the study of the immune system.
2. To study about the various immune responses of the human system towards the pathogens.

### **UNIT I**

Infection – Immunity and its types (Innate and Acquired) Outlined classification of Immune cells-Types of Immune cells - B-lymphocytes, T-lymphocytes and its types- Macrophages, cells mediated immunity and lymphokine activated killer, Organs of immune system – Bone marrow, thymus, spleen, lymph nodes, MALT and GALT.

### **UNIT II**

Nature of antigens & characteristics. Antibodies and functions of IgG, IgA, IgM, IgD and IgE - Isotypes, allotypes and idiotypes - Major Histocompatibility Complex (MHC)-Human Leukocyte Antigen (HLA)- complement fixation reaction, classical and alternative pathways – opsonins and opsonisation - Clonal selection theory

### **UNIT III**

Antigen antibody reactions- agglutination, precipitation in liquids and semisolids (Ouchterlony technique) - ELISA, RIA, Immune blot, Immunofluorescence, Immuno diffusion, Immuno electrophoresis.

### **UNIT IV**

Hypersensitivity – Immediate and delayed type hypersensitivity reactions - Congenital (primary) immunodeficiency - autoimmunity- Transplantation immunology, Tumor immunology.

### **UNIT V**

Monoclonal antibody and its applications – Immune deficiency diseases - immune response to infectious diseases – viral infections, bacterial infection and protozoan diseases – Immune response in AIDS - Vaccines and its types – immunization Schedule-Stem cell, cell lines.

### **Reference Books:**

1. Donald. M. Weir and John Steward. (1993) Immunology (7<sup>th</sup> Edition). ELBS, London.
2. Hus Davis. (1997). Introduction Immunology (1st Edition). Chapman & Hall Publisher, London.
3. Ivan M.Roit (1998). Essential Immunology- Blackwell Scientific Publications, Oxford.
4. Paul (1998). Essential Immunology, (2<sup>nd</sup> Edition), Raver Press, New York.

5. Peter J. Delves and Ivan M. Roit (Eds) (1998) Encyclopedia of Immunology – (2<sup>nd</sup> Education) Academic Press.
6. Ridklad, M. Aydl (1995). Immunology, (2<sup>nd</sup> Education), Baltimore, hongkong, NMS Publication.
7. Roit, J.M. Brostaff, J.J. and Male, D.K. (1996). Immunology (4<sup>th</sup> Education C.V. Mosby publisher, St.Louis.
8. Stewart Sell. (2001) Immunology, Immunopathology and Immunity. (6<sup>th</sup> Education), ASM Press, USA.
9. Ananthanayanan,R., and Panicker,J. (2000). Text Book of Microbiology. Orient longmans.
10. Rajan, S. (2007). Medical microbiology. MJP Publisher, Chennai.
11. Fathimunisa Begum (2008). Monoclonal antibodies: The hopeful drugs. MJP Publisher, Chennai.
12. Kannan.I (2007) Immunology. MJP Publisher, Chennai.

<b>SEMESTER – II</b>			
<b>CORE VI</b>			
<b>MEDICAL MICROBIOLOGY</b>			
<b>Code : 17PMIC23</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 60</b>	<b>Credit: 5</b>

## **OBJECTIVES**

To impart advanced level information in the subject of Medical Microbiology.

### **UNIT I**

Basics in Medical microbiology - Infectious diseases overview. Medically important microbes. Microbial diseases - sources, **route** of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases. Bacteriology - *Staphylococci, Bacillus, Clostridium, Corynebacterium, Salmonella, Klebsiella, Vibrio, Pseudomonas, Mycobacteria*.

### **UNIT II**

Virology - Structure, multiplication, classification and medical importance of DNA

viruses - General properties of viruses host interaction- Pox virus( small pox, )-Herpes virus-(Chicken pox, Herpes looster,)-Adenovirus-Orthomyxovirus( Influenzavirus, Swine Flu)- Paramyxovirus,-Enterovirus (Poliovirus)- Arbovirus-(Chikungunga virus, Dengue)- Hepatitis virus- Rotavirus- Rubella virus – Ebola virus –AIDS-SARS

### **UNIT:III**

Mycology - Human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida, opportunistic mycoses.

Parasitology - Medical importance of Entamoeba, Giardia, Taenia, Ascaris, .

Laboratory techniques in parasitology.

### **UNIT:IV**

Chemotherapy – Basics of chemotherapy, history and development chemotherapy, general properties of antimicrobial agents and attributes of an ideal antimicrobial agents – Principal groups of antibacterial agents and mechanism of action : Inhibitors of cell wall – Inhibitors of protein synthesis – Inhibitors of nucleic acid synthesis – Inhibitors of DNA replication and inhibitors of RNA polymerase – Inhibitors of cytoplasmic membrane function .

### **Unit – V**

Antibacterial, antifungal and antiviral agents – Drug resistance (Origin, mechanisms and transmission) – Selection and testing Factors influencing the selection of drugs – Resistant Staphylococci and testing of antibiotics; (Checker board assay, Schlichter's Test and E-test).

### References:

1. Ananthanarayanan, R. and Panicker. J. (2000). Text Book of Microbiology. Orient Longmans.
2. Rajan. S. (2007). Medical Microbiology. MJP Publisher, Chennai. Bernard. D. Davis, Renato Dulbecco, Herman N. Eisen and Harold, S. Ginsberg. (1990). Microbiology (4<sup>th</sup> Edition) J.B. Lippincott Company, New York.
3. Prescott L.M. Harley J.P., and Klein D.A (2008). Microbiology (7<sup>th</sup> Edition) McGraw Hill, New York.
4. Pelczar Jr .M. J. Chan E.C.S. and Kreig N.R (1993). Microbiology- Mc Graw Hill, Inc., New York.
5. Dubey R.C. and Maheswari, S. 2003 A Text Book of Microbiology. S. Chand & Co., New Delhi.
6. Madigan M., T., Martinko. J.M., and Parker J., Brock TD. (1997). Biology of Microorganisms. (8<sup>th</sup> Edition). Prentice Hall International Inc, New York.
7. Nester, E.W. Roberts, C.V. and Nester, M.T. (1995). Microbiology, A Human perspective. IWOA, U.S.A.
8. Pelczar Jr. M.J. Chan E.C.S. and Kreig N.R (1993). Microbiology – Mc Graw Hill, Inc., New York.
9. Stainer R.Y., Ingraham J.L., Wheelis M.L., and Painter P.R. (1986). General Microbiology, Macmillan Education Ltd., London.
10. Tortora, Funke, Case Addison 2001, Microbiology – An Introduction – 7<sup>th</sup> Edition, Wesley Longman Inc.
11. Dubey R.C. and Maheswari, S. 2003 A Text Book of Microbiology. S. Chand & Co., New Delhi.
12. John L. Ingraham and Catherine A Ingrahani. (2000) Introduction to Microbiology. Books / Cole Thomas Learning, New York.



<b>SEMESTER – II</b>			
<b>ELECTIVE – II</b>			
<b>RURAL BIOTECHNOLOGY</b>			
<b>17PMIE21</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 4</b>	<b>Credit: 4</b>

**Objectives:**

To impart knowledge on various biotechnological commercial processes and its usefulness.

To provide hands on exposure to various biotechnological commercial processes such as biogas production, composting methods, mushroom production, spirulina cultivation and ornamental fish cultivation.

**Unit-I: Biogas technology.**

Introduction and binary – anaerobic digestion – microbes involved – factors influencing methane – production – stages of methane generation – waste used in methanogenesis – various bioreactors used for methane generation – advantages and disadvantages. Visit in biogas production units with field demonstration.

**Unit-II: Composting technology.**

Historical background – waste availability- factors influencing – methods – biomaturity – enrichments of compost and crop productivity. Vermiculture technologies: History – species – life cycles – methods – different types of waste suitable for vermicomposting. Utilization of vermicompost for crop production. Visit to vermicompost industries with field demonstration.

**Unit-III: Mushroom technology.**

Bioconversion of organic wastes into protein – oyster mushroom technology, paddy mushroom, milky mushroom and button mushroom technology, post harvest technology. Mushroom farming and prospects. Visit to mushroom farms with field demonstration.

**Unit- IV: *Spirulina* cultivation technology.**

Biology of *spirulina* – cultivated methods, post harvest technology and single cell protein formulation. Visit to *Spirulina* industries with field demonstration.

**Unit-V: Ornamental fish culture.**

Present status and importance- popular varieties – artificial and live feeds – breeding techniques of egg layers- gold fish, angel fish, fighter and barbs – live bearers – guppy, molly, platy and sword tail – economics . Visit to ornamental fish farms with field demonstration.

**Text books:**

- 1) Vonshak, A.2004. Spirulina plantensis – physiology, cell biology and biotechnology. Taylor and frencis, London.
- 2) Kawl, T.N. 1999. Introduction to mushroom science, oxford and IBM co., Pvt. Ltd., New Delhi.
- 3) Philip G. Miles, Shu- ting chang, 1997. Mushroom biology , world scientific, Singapore.
- 4) Bahl, N .1988. Hand book on mushroom. Oxford and IBH publishing Co.,Pvt Ltd., New Delhi.
- 5) Tripati. G. 2003. Vermiresources technology, 1<sup>st</sup> Ed., Discovering Publication House, New Delhi.
- 6) Gaur, A.C., 1999. Microbial technology for composting of Agricultural Residues by Improved Methods, 1<sup>st</sup> Print, ICAR, New Delhi.
- 7) Subba Rao, N.S., 1999. Soil Microbiology, 4<sup>th</sup> Ed, oxford IBH publishing Co. Pvt. Ltd., New Delhi.
- 8) Chawla O.P. 1986. Advances in Biogas Technology, ICAR, New Delhi.
- 9) Martin Alexander 1976. Introduction to soil Microbiology, Wiley eastern Ltd., New Delhi.
- 10) Anita Saxena, 2003. Aquarium management Daya Pub. House , New Delhi.
- 11) Srivastava, C.B.I., 2002. Aquarium fish keeping. Kitab Mahal, Allahabad.

**References:**

1. Kumar , H.D., 1991. A textbook on Biotechnology , II Edition , East- west press Pvt Ltd., New Delhi.
2. Chatwal, G.R., 1995. Textbook of Biotechnology, Anmol Publications Pvt. Ltd., New Delhi.
3. Jarsa , O.P., 2002 . Environmental Biochemistry, I Ed., Sarup& Sons, New Delhi, India.

SEMESTER – II			
ELECTIVE – II VERMI TECHNOLOGY			
17PMIE21	Hrs/ Week: 6	Hrs/ Sem: 4	Credit: 4

**OBJECTIVES:**

To impart advanced level knowledge in vermicomposting

**UNIT-I:**

Earth worm classification – Morphology and anatomy. Biology of *Lampitomaruitii*. Vermicomposting - Definition, introduction and scope- The nature of earthworms-soil environment-basic environmental requirements.

**UNIT-II:**

Vermicomposting materials and their classification. Physical, chemical and biological changes brought by earth worm in soil structure-carbon,nitrogen and phosphorous transformations

**UNIT-III:**

Veermicomposting methods - Optimal conditions for Vermiculture - temperature, moisture, pH, soil type, organic matter,

**UNIT-IV:**

Vermicomposting in Homes, Maintenance of vermicomposting beds. Harvesting the worms. Earth worm predators, parasites and pathogens. - Vermi wash.

**UNIT-V:**

Composting - Vermicomposting - Required conditions - Advantages - Application of vermicomposting, Field sampling- passive methods.

**REFERENCES:**

1. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3rd Edition, Chapman and hall.
2. Jsmail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.
3. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.
4. Ranganathan L.S. 2006. Vermibiotechnology from soil health to human health. Agrobios India.
5. Gupta P.K. 2008. Vermicomposting for sustainable agriculture. Agrobios. India.

<b>SEMESTER – II</b>			
<b>ELECTIVE – II</b>			
<b>MUSHROOM TECHNOLOGY</b>			
<b>17PMIE21</b>	<b>Hrs/ Week: 6</b>	<b>Hrs/ Sem: 4</b>	<b>Credit: 4</b>

#### **UNIT I:**

Mushroom Technology - Introduction, History and Scope –Morphology of mushroom -Vegetative characters - Formation and development of Basidiocarp, structure of basidiocarp - *Agaricus*.Edible and Poisonous Mushrooms.Medicinal and nutritive value of edible mushrooms.Food preparation- soup, cutlet, vegetable curry, samosa, omlette and pickle. Mushroom research centres in India.

#### **UNIT II:**

Cultivation of button mushroom (*Agaricusbisporus*), milky mushroom (*Calocybeindica*), oyster mushroom (*Pleurotussajor-caju*) and paddy straw mushroom (*Volvariellavolvcea*).Preparation of Pure Culture and spawn cultivation methods.

#### **UNIT III:**

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

#### **UNIT IV:**

Structure and construction of Mushroom House- Layout of traditional and green house method. Methods of Mushroom cultivation: Bed Method, Polythene Bag Method. Methods of Composting-Long method of composting (LMC) & Short method of composting (SMC).

#### **UNIT V:**

Diseases: Common pest, microbes (Bacteria, Fungus and Virus). Diseases of Mushrooms: Brown black disease,yellowing of oyster mushrooms,Bacterial soft rot, fungal brown blotch, wet bubble,dry bubble, cob web, green blotch. Principles of insect pest control: Principles and methods of pest management -chemical control.

SEMESTER II			
PRACTICAL – II			
TECHNIQUES IN BIOCHEMISTRY, IMMUNOLOGY & MEDICAL MICROBIOLOGY			
CODE: 17PMICR2	Hrs/Week: 6	Hrs/Sem: 90	Credits: 3

## OBJECTIVES

To impart advanced practical knowledge in Microbial Physiology, Biochemistry Immunology and Medical Microbiology.

1. Principles of Colorimetry -Verification of Beer's law.
2. Estimation of proteins by Lowry's method.
3. Separation of amino acid by paper chromatography.
4. Separation of amino acid by thin layer chromatography.
5. Precipitation reaction based on immunodiffusion  
test a. ODD, b. Single Radial Immunodiffusion
6. WIDAL test – qualitative & quantitative assay.
7. RPR test for syphilis
8. Agglutination reaction with reference to blood grouping & RH typing.
9. Latex agglutination test (ASO)
10. Isolation of normal flora of the skin and throat
11. Urine culture and its microbiological analysis (*E.coli*)
12. Isolation of Enteric pathogen from stool – (*Vibrio*) .
13. Antibiotic sensitivity test – Kirby Bauer method.
14. Determination of minimal inhibitory concentration.
15. Isolation & identification of pathogens from wound and pus.

## Reference Books:

1. Microbiology laboratory manual T. Sundaraj, AswathySundararaj, Chennai, 2002.
2. Practical microbiology R.C. Dubey &Maheswari, S. Chand &Co.Ltd., New Delhi, 2002.
3. Cappuccino & Sherman, Microbiology a laboratory manual, 2002. Experiments in Microbiology Plant pathology & Biotechnology, K.R. Aneja, Fourth edition, New age international (p) Limited, Publishers.
4. Kannan. N. (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
5. Kanai L. Mukherjee, Medical Laboratory Technology – A procedure manual for routine diagnosis tests – Tata McGraw – Hill Publishing Co., Ltd., New Delhi. Vol.I-III.
6. Cappuccino & Sherman, Microbiology A laboratory manual, 2004.
7. R.C. Dubey &Maheswari, Practical Microbiology. S. Chand &Co.Ltd., New Delhi.
8. Janarathanan& Vincent, Practical Biotechnology: Methods & Protocols 2007 Universities press.
9. P. Palanivelu, Analytical Biochemistry & Separation Techniques, second edn 2001.

<b>SEMESTER –II</b>	
<b>SELF STUDY COURSE(COMPULSORY) – QUALITY ASSURANCE TECHNIQUES IN SEA FOOD PROCESSING INDUSTRY</b>	
<b>Code : 17PMISS1</b>	<b>Credits: +2</b>

### **OBJECTIVES**

To impart advanced level information about the Quality control in the laboratory.

#### **UNIT-I:**

Quality assurance in sea food industry- Hazard analysis critical control point (HAACP) and Good Manufacturing practices (GMP) .

#### **UNIT-II:**

Standard sanitary operating procedures (SSOP) and Sanitary Control Procedures (SCP)

#### **UNIT-III:**

Microbial hazards detection and identification - *Listeria monocytogenes*, *Salmonella* and *Vibrio Cholerae*.

#### **UNIT-IV:**

Enumeration of surface, air and water microbes.

#### **UNIT-V**

National standard for sea foods and seafood industries

#### **REFERENCES:**

- 1) Quality control of fish and fishery products –compiled and edited by Dr.G.Jeyasekaran. Dr (Mrs.) R.JeyaShakila, Dr.P.Velayutham.
- 2) Fish Processing Plant-Guidelines for the application of HACCP program –prepared by Food Protection Services, BC centre for disease control-Revised January 2011.

<b>SEMESTER- III</b>			
<b>CORE – VII</b>			
<b>AGRICULTURAL AND ENVIRONMENTAL MICROBIOLOGY</b>			
<b>Code:17PMIC31</b>	<b>HRS/WEEK: 6</b>	<b>HRS/SEM: 90</b>	<b>CREDITS: 5</b>

## **OBJECTIVES**

1. To inculcate the knowledge on interaction between microbes and environment.
2. To impart advanced information in Agricultural Microbiology.

### **UNIT I :**

Based on oxygen requirement, nutrition, temperature, habitat (soil, water & air). Physio-chemical properties of soil -Rhizosphere and rhizoplane organisms. Mineralization and Immobilization. Biogeochemical cycling: Carbon, Nitrogen, Phosphorus & Sulphur.

### **UNIT II :**

Microbial analysis of drinking water: Tests for coliforms ( presumptive, confirmed and completed tests). Purification of water: Sedimentation, Filtration (slow and rapid sand filters) and Disinfection. Aeromicrobiology – Phylloplane microflora (morphological, physiological characters: nutrition, radiation, relative humidity and temperature) – Air Pollution – aerosol, droplet nuclei and infectious dust. Examination of air microflora.

### **UNIT III :**

Nature of sewage and its composition. Physical, chemical and biological properties of sewage (BOD, COD etc). Sewage systems and types. Sewage Treatment: Single Dwelling Unit, municipal sewage treatment – primary, secondary and tertiary treatments (Trickling filters, Activated sludge process, Oxidation lagoons and Imhoff tank).

### **UNIT – IV**

Biological Nitrogen fixation- The range of nitrogen fixing organisms-mechanism of nitrogen fixation (biochemistry of nitrogenase) - genetics of nitrogen-fixation - Rhizobium-Legume Association - N<sub>2</sub> fixation by non-leguminous plants.

### **UNIT – V**

Microbial products and plant health: PGPR (plant growth promoting rhizobacteria) - significance of mycorrhizae - Role of biofertilizers and biopesticides-Biofertilizers-(*Rhizobium*, *Azospirillum*, *Azotobacter*, *Cyanobacteria*, *Phosphobacteria* and *Azolla*)-Inoculants, mass production and method of application and its Quality Control (BIS specification).

## **REFERENCE BOOKS:**

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

5. SubbaRao,N.S.(1995). Soil Microorganisms and Plant growth. Ed,Oxford and IBH Publishing Co, Pvt. Ltd, NewDelhi
6. Wheeler, B.E. (1976). An introduction to Plant disease. ELBS and John Wiley and sons, Ltd.
7. Rangaswamy.g., and Bagyaraj.D.J. (1996). Agricultural Microbiology. Prentice-Hall of India Pvt Ltd., New Delhi.
8. Dirk, J. Elsas, V., Trevors,.T., and Wellington, E.M.H. (1997). Modern Soil Mirobiology. Marcel Dekker INC, New York, HongKong.
9. Dubey R.C. (2001).A Text Book of Biotechnology. S Chand & Co. New Delhi.
10. Gupta,S.K.(2014).Approaches and trends in plant disease management. Scientific publishers.Jodhpur,India.
11. Jammaluddin et al (2013). Microbes and sustainable plant productivity. Scientific Publishers Jodhpur,India,G.
12. Purohit, S.S.Kothari,P.R.andMathur (1993). Basic and Agricultural Biotechnology, Agrobotanical Publishers (India).Bikaner.



<b>SEMESTER –III</b>			
<b>CORE VIII</b>			
<b>RESEARCH METHODOLOGY</b>			
<b>Code : 17PMIC32</b>	<b>HRS/WEEK: 6</b>	<b>HRS/SEM: 90</b>	<b>CREDITS: 5</b>

## **OBJECTIVES**

To impart advance level information in the subject on Research methodology, Biosafety, Bioethics, Patenting and IPR.

### **UNIT – I : Microscopy, pH and buffer**

General laboratory procedures and maintenance of research equipments- microscopy-general principles-confocal microscope, SEM and TEM –pH basic principles and construction of pH meter- pH electrodes- Principles and application of buffers – Mechanism of buffer action and preparation of common buffers –Citrate, acetate, tris and phosphate-Application of buffers-pH measurements of soil and water.

### **UNIT – II : Isolation, Fractionation and Separation**

Isolation, Fractionation and Separation of cellular constituents – Isolation of chloroplasts, mitochondria, nucleic acids and enzymes – homogenization –Manual, mechanical and sonication –centrifugation-centrifuges and their uses- Micro centrifuge, high speed refrigerated centrifuges, ultra centrifuges, differential and density gradient centrifugation – Chromatography –paper, thin layer-separation of amino acids and sugars-Gas liquid chromatography, HPLC and PCR –principle and applications.

### **UNIT – III :**

Electrophoresis –principles, factors affecting electrophoretic mobility – support medium –Agarose and polyacrylamide gels- Electrophoresis of proteins and nucleic acids-Spectroscopic techniques –UV –visible, MALDI-TOF, LC-MS and AAS-principles, Instrumentation and applications-Estimation of cellular constituents- Sugars, amino acids and proteins –Flame photometer and Bomb calorimeter- principle and applications.

### **UNIT – IV : Research and Project writing methods**

Research-definition, objectives, types and importance-Research methods in biological sciences- Research process- Literature survey – sources –scientific databases- Research report writing – Parts of Thesis and Dissertation –Title, certificate, declaration, acknowledgements, contents, List of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods-Results – Presentation of data – Tables, figures, map, graphs, photographs – Discussion – Summary, Bibliography/ References and Appendix.

### **UNIT – V : Article Publication**

Presentation in seminars and conferences – Writing scientific paper – Organization of scientific paper – Importance of title – abstract –key words, Introduction, materials and methods, results, Discussion. Acknowledgements and References – Publication in research journals – Standards of Research journals- Peer – review – impact factor – citation index – Preparation of manuscript – Proof correction – proof correction marks- method of correcting proof- Writing chapters in books – Preparation of Research proposal and funding agencies – Research fellowships.

## REFERENCE BOOKS:

1. Vijayalakshmi.G. and C.Sivapragasam (2008). Research Methods (Tips and Techniques). MJP Publishers, Chennai.
2. Gurumani.N. (2006). Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. Ramamurthi and Geetha Bali (2007). Bioethics and Biosafety. APH Publishing, New Delhi.
4. Biszley, R.E.(1991). Patenting animals in Europe, *Biotechnology*. 9:6 192- 622
5. Crespi, R.S. (1991). Biotechnology and Intellectual property. Part- I, Patenting In Biotechnology, *TIP TECH* 9:117-121.
6. Ehrlich, P.R., and Wilson, E.O.(1991). Biodiversity Studies – Science and. Policy. *Science* 253: 758- 762.
7. Eisenberg, R.S. (1992). Genes, Patents and product Development. *Science*, 257: 903-906.
8. Gill. K.S. (1991). Implications of intellectual property rights for Agricultural Sector in India. *Crop Improve*. 18: 81-87.
9. IDRC Report (1991). A patent on life: Ownership of Plant and Animal Research. IDRC, Ottawa, Canada.pp 40.
10. Marx. J.L. (Editor) (1989). A Revolution in Biotechnology. Cambridge Univ. Press. Cambridge.

SEMESTER - III			
CORE –IX			
INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY			
Code: 17PMIC33	HRS/WEEK: 6	HRS/SEM: 90	CREDITS: 5

### OBJECTIVES:

1. To inculcate the knowledge of Industrial and Pharmaceutical Microbiology
2. To impart the students with the knowledge of various processes involved in Pharmaceutical industry.

### UNIT-I

Isolation, preservation and improvement of industrially important microorganisms; Raw materials and media design for fermentation processes; Sterilization; Development of inoculums for industrial fermentations; Types of fermentation: Batch, Continuous, Dual or Multiple, Surface, Submerged, Aerobic and Anaerobic.

### UNIT-II

Fermenter- Design and types, Instrumentation and control-aeration and agitation. Recovery and purification of fermentation products. Enzymes and cell immobilization, Production of recombinant proteins having therapeutic and diagnostic applications: Insulin, Interferon, Somatotropin, Single cell protein.

### UNIT-III

Biology of industrial microorganisms. *Streptomyces*, Yeasts (*Saccharomyces*, *Hansenula*) *Spirulina* and *Penicillium*. Mushroom cultivation. Biosensors and Biochips. Biofuels from microbial sources.

### UNIT-IV

Alcohols (Ethanol and Butanol); Beverages (Beer and Wine); Aminoacids (Glutamic acid and Lysine); Organic acids (Citric acid and acetic acid); Vaccines (Plant – *Agrobacterium tumefaciens*, Animal – Leptospirosis, Microbes - DPT).

### UNIT-V

Antibiotics (Penicillin, Cephalosporin and Streptomycin); Vitamins (Riboflavin and Cyanocobalamin); Production of enzymes (Protease, Amylase and Lipase); Biopolymers (Xanthan gum and PHB); Biopreservatives (Nisin); Production of Hormones (Testosterone and Androstenedione).

## REFERENCE BOOKS:

1. WulfCrueger (2000).A Text Book of IndustrialMicrobiologyII.Ed. Panima Publishing Corporation,NewDelhi.
2. Peter F.Stanbury., Whittaker, A. and Hali,S.J.(1997 ).Principles of Fermentation Technology,II Ed., Pergamon Press.
3. A.H.Patel, Industrial Microbiology (1996).Macmillan India Limited.
4. Reed.G.(Editor),Industrial Microbiology, CBS Publishers
5. Prescott &Dunn(1997). Industrial Microbiology.CBS publishers and Distributors.
6. Casida,L.E.(1986).Industrial Microbiology. Eastern Limited, NewYork.
7. Michael J.Waites, Neil L.Morgan, John S.Rockey and GrayHigton(2001). Industrial Microbiology An Introduction, Replika press Pvt.NewDelhi.
8. S. S. Purohit, H.N. Kakrani, A.K. Saluja, Pharmaceutical Biotechnology (2006). Student edition, Jodhpur.
9. U. Satyanarayana, Biotechnology (2013). Books and Allied (P) Ltd, Kolkata.

<b>SEMESTER – III</b>	
<b>RESEARCH PROJECT</b>	
<b>CODE: 17PMIP31</b>	<b>CREDITS: 5</b>

## **OBJECTIVES**

1. To impart advanced level information for doing a Research Project Individually and to visit to Hi-Tech Industries / Institutes
2. To develop self confidence through paper presentation and skill based training at workshops and get acquainted to subject interviews.

## **RESEARCH PROJECT**

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

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

## **INDUSTRIAL VISIT**

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

## **PRESENTATION OF SCIENTIFIC FINDINGS**

Each student will have to present their scientific findings of individual work (or) collaborative work in any State / Regional / National International Seminar or Symposia. Alternatively, they can attend any workshops conducted by the State / National Organizations of Scientific Recognition. Abstracts / Papers presented along with certificates will have to be

produced during examination. Scientific papers published in Journals / Proceedings during his / her Master Programme will be given special weightage.

### **GENERAL VIVA - VOCE**

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

<b>SEMESTER – III</b>			
<b>PRACTICAL –III</b>			
<b>TECHNIQUES IN AGRICULTURAL, ENVIRONMENTAL, INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY</b>			
<b>Code: 15PMICR3</b>	<b>Hrs/week: 6</b>	<b>Hrs/Sem: 90</b>	<b>Credits: 3</b>

**OBJECTIVES:**

To impart advanced level practical training in Agriculture and Industrial Microbiology.

1. Isolation of *Rhizobium* from root nodules of leguminous plants.
2. Isolation of *Azotobacter* from soil.
3. Isolation of antibiotic producing microbes from soil.
4. Testing antagonistic activity of soil microorganisms
5. Assessment of VAM colonization
6. Estimation of soil mineral contents a) pH b) nitrate c) nitrite d) sulphate e) phosphate.
7. Isolation of air borne bioparticles.
8. Isolation of coliforms from sewage.
9. Effect of high salt concentration on microbial growth.
10. Determination of biological oxygen demand
11. Determination of chemical oxygen demand
12. Production of citric acid by *Aspergillus niger*.
13. Bio ethanol production
14. Amylase production
15. Protease production
16. Immobilization of yeast cells using sodium alginate Bioassay of chlormphenicol by plate assay method or turbidimetric Assaay method
17. Sterility testing by *Bacillus stearothermophilus*
18. Determination of antimicrobial activity of a chemical compound (Phenol, Resorcinol, Thymol, Formaldehyde) to that of phenol under standardized experimental conditions.

**REFERENCE BOOKS:**

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

<b>SEMESTER- III</b>	
<b>SELF STUDY COURSE (OPTIONAL) -PROBIOTICS</b>	
<b>CODE:17UMISS2</b>	<b>CREDITS: +2</b>

**OBJECTIVES:**

To impart current knowledge of probiotics, prebiotics and functional dairy foods for the health benefits .

**UNIT:1**

Probiotics: Introduction and history of Probiotics, Probiotic microorganisms.

**UNIT:II**

Characteristics of Probiotics for selection: Tolerance to additives, stability during storage, stability maintenance of probiotic microorganisms.

**UNIT:III**

Role of probiotics in health and disease: prevention and treatment of gastrointestinal bacterial infection treatment of chronic urinary tract infection, antitumor and cholesterol level

**UNIT:IV**

Mechanism of probiotics: production of antimicrobial substances, modulation of immune system, alteration of intestinal bacterial metabolite action

**UNIT:V**

. Prebiotics: concept, definition, criteria, types and sources of prebiotics, prebiotics and gut microflora- Prebiotics and health benefits: mineral absorption, immune response, cancer prevention, elderly health and infant health, prebiotics in foods.

**REFERENCES:**

1. Salminen. S and Wright , A. V. 1998. Lactic Acid Bacteria, Marcel Dekker
- 2 Glenn R. G. Marcel R. 2008. Handbook of Prebiotics CRC press
- 3 Lee Y K, Salminen S 2009. Handbook of Probiotics and Prebiotics . A John Willey and Sons Inc. Publication
- 4 Sandholm T. M. Saarela M. 2003. Functional Dairy Products CRC Woodhead Publishing Ltd



SEMESTER IV			
Core X : Marine Biology			
Code: 17PBCC41	Hrs /Week : 6	Hrs / Sem: 90	Credits : 5

## Objectives

To make the students realize the potentiality of marine environment  
 To understand the marine ecosystem threats and conservation

### Unit I Marine Environment – Zonation and Biota

Sea as a biological environment. Classification of marine environment.– Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores –features of the flora, fauna and adaptations. Role of marine micro-organisms (bacteria and fungi) in nutrient cycles(nitrate, phosphate and sulphate)

### Unit II Characteristics of Sea Water

Physical properties: waves, tides, currents- types, causes , and their impact on marine organisms. Illumination, temperature, pressure,. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

### Unit III Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef -- ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

### Unit IV Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

### Unit V Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi, macro algae and sponges). Phycocolloids; agar-agar and algin.

### Books for Reference

1. Tait, R.V. and Dipper F.A (1998) Elements of marine ecology. -4th ed. British Library Cataloguing in Publication Data.
2. Gross, G., 1993. Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., New Jersey.
3. McCormick, J.M. and J.V. Thiruvathaakal, 1976. Elements of Oceanography. W.B.

Saunders Company, Philadelphia.

4 .Nybakken, J.W. 1997. Marine Biology – An Ecological Approach. Addison Wesley Longman, Inc. California, 477pp.

5. Olivia J.Fernando 1999.Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur

6. Russel 1970. Marine Ecology, Academic Press- London and New York

7. Nelson and Smith 1973, Oil pollution and Marine Ecology-Plenum press

8. Benjamin- Cummings, Menlo Park, California.Vijaya Ramesh, K. (2004). Environmental Microbiology.MJP Publishers Chennai.

9.MoshrafuddinAhamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai

10.Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

### **PRACTICALS**

**Hrs / Week : 2**

1.Determination of acidity

2 Determination of salinity

3 Determination of alkalinity

4 Determination of total hardness

5. Determination of nitrite

6. Determination of phosphate

7 .Biochemical test for micro-organisms-IMViC

8. Collection and identification of marine plankton ( any three phyto and zooplanktons ) 9.Identification and remarks of the following

i.Plankton net

ii Inter-tidal organisms

a.Rocky shore :Sea anemone,

*Chiton* b.Muddyshore:*Uca*, *Cerithidia*

c.Sandy shore: *Arenicola*, *Murex*

ii.Food fishes: *Cybium*,*Sardinella*

iiiSea weeds: *Gracilaria*,*Sargassum*,

. 10. Submission: Record Note Book

SEMESTER – IV			
CORE –XI MICROBIAL GENETICS & MOLECULAR BIOLOGY			
Code: 17PMIC41	Hrs/ Week: 6	Hrs/ Sem: 90	Credit: 5

## OBJECTIVES

To make the students knowledgeable in the field of Microbial Genetics and Molecular Biology.

### UNIT I

Historical aspects and current concepts of Molecular Biology - Experimental evidence for Nucleic acids as genetic information carriers - DNA features: Superhelicity, linking number, topological properties – Melting of DNA - DNA replication: General principles, modes of replication, proof reading – Enzymology of DNA replication.

### UNIT II

Relationships between replication and cell cycle- Inhibitors of DNA replication (Blocking precursor synthesis, nucleotide polymerization and altering DNA structure),- DNA damage and repair – Types of DNA damage (Dimeration, oxidative damage, alkylation pyrimidine dimers) – Repair pathways : Methyl directed very short patch repair, nucleotide excision repair, base excision repair, recombinational repair and SOS repair.

### UNIT III

Transcription in Prokaryotes - General principles, basic apparatus, types of RNA polymerases, steps in initiation, elongation and termination, inhibitors of RNA synthesis – Polycistronic and monocistronic RNAs – Control of transcription by RNA polymerases, promoter regions, sigma factors – Controlled termination: Attenuation and anti – termination – Protein synthesis: Steps, details of initiation elongation and termination, role of various factors, inhibitors – Signal hypothesis.

Regulation of gene expression: Operation concept, catabolite repression, instability of bacterial RNA, negative regulation (*E.coli*, lac operon), Positive regulation (*E.coli* ara operon) – Regulation by attenuation (trp operon). Maturation and processing of RNA: Methylation, trimming of rRNA - Capping, Polyadenylation and splicing of mRNA – Cutting and modification of tRNA.

### UNIT IV

Gene as a unit of mutation and recombination – Mutants and mutation, mutagens, revertants, spontaneous mutation, mutant isolation, mutagenesis and it's types, suppression – Plasmids: Types, detection, transfer, replication and properties. Transposable elements – Nomenclature, classes, IS elements, Transposons – Composite structure and complex transposon structure, mechanism of transposition.

### UNIT V

Gene transfer mechanisms: Transformation modes, transformation, natural and artificial competence, DNA uptake, molecular mechanisms of transformation in *Bacillus* sp and *E.coli* recombination and genetic mapping, Bacterial conjugation – F plasmid, structure and function, origin of conjugation (Hfr and F+) Interrupted and uninterrupted mating, time map and recombination map, conjugation in *E.coli*, colicins and col factors.

Transduction – Generalized and Specialized – Lambda phage and P1 Mechanism of gene transfer through lambda and P1 Phages – HFT and LFT lysate – Co transduction – Transduction mapping.

**Reference Books:**

1. Freifelder D. (1991). Molecular Biology. Narosa Publishing House
2. Jeyanthi, G.P (2008) Molecular Biology. MJP Publisher, Chennai.
3. Veer BalaRastogi (2008) Fundamentals of Molecular Biology. Ane Books India.
4. Raja Pandian. K., Shanthi. S (2011). Molecular Biology and Microbial Genetics. PBS Book Enterprises.
5. Avinash ., KakoliUpadhyay (2005). MolBio - Fundamentals of Molecular Biology . Himalaya Publishing House.
6. Satyanarayana. U (2013). Biotechnnology – Books and Allied (P) Ltd.
7. Mohan P. Arora., Gurdarshan., Sandhu. S (2004). Genetics. Fifth Edition. Himalaya Publishing House.
8. Sambamurty.A.V.S.S (2011). Molecular Biology. Narosa Publishing House.

SEMESTER – IV			
CORE – XII FOOD MICROBIOLOGY			
CODE:17PMIC42	HRS/WEEK: 6	HRS/SEM: 90	CREDIT: 5

### OBJECTIVES:

To impart advanced level information in the subject on Food Microbiology.

#### UNIT – I

Food as a substrate for microorganisms – Microorganisms in food materials – Molds, yeasts and bacteria –General characteristics, classification and importance – Principles of food preservation, asepsis, removal of microorganisms (Anaerobic condition, high temperature, low temperature, drying) – Factors influencing microbial growth in food – Extrinsic and intrinsic factors (Nutrient content, pH, Redox potential, Relative humidity, temperature, gaseous atmosphere). Chemical preservatives – Food additives – Canning – Processing by heat treatment.

#### UNIT – II

Food borne infections and intoxications: bacterial and nonbacterial - Examples of infective and toxic types – *Bacillus*, *Clostridium*, *Escherichia*, *Staphylococcus*, Toxigenic algae and Fungi, Mycotoxicosis and Viral toxins – Food borne outbreaks – Laboratory testing procedures – Preventive measures.

#### UNIT – III

Types of fermentation: Solid substrate (Fermentation and medium), submerged fermentation (process of production, factors influencing submerged cultures) – Food fermentation: Bread, Shoyu, Tempeh, Fermented dairy products (buttermilk, cream, yoghurt, kefir, koumiss, acidophilus milk) - Experimental and industrial production methods – spoilage and defects of fermented dairy products.

#### UNIT IV

Methods of food preservation – Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, chemicals – organic acids, nitrates, nitrites, sulphur di oxide and sulphites. Radiation - UV, Smoking.

#### UNIT – V

Microbiological examination of foods – Estimation and examination of specific microorganisms, quality and safety assurance in food and dairy industry. Good manufacturing practice, hazard analysis and critical control point (HACCP) concept. BIS Laboratory services.

### REFERENCES BOOKS:

1. Adams, M.R. and Moss, M.O. (1995). Food Microbiology. The Royal Society of chemistry, Cambridge.
2. Frazier, W . C . And Westhoff, D . C . (2008) Food Microbiology . (4<sup>th</sup> edition).Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Jay, J.M. (1987), Modern Food Microbiology. CBS Publishers and Distributors, New Delhi.

4. Atlas, R.M. (1989), Microbiology – Fundamentals and Applications, Macmillian Publishing Company.
5. Banwart, G.J. (1989). Basic Food Microbiology. Chapman & Hall New York.
6. Board, R.C. (1983), A modern Introduction to food Microbiology Blackwell Scientific Publication, Oxford.
7. S.N. Tripathy (2006). Food Biotechnology, Dominant Publishers and Distributors, New Delhi.
8. Robinson.R.K. (1990). Dairy Microbiology. Elsevier Applied Sciences, London.
9. Vijaya Ramesh, K., (2007) Food Microbiology, MJP Publishers, Chennai.

SEMESTER –IV			
ELECTIVE -III- GENETIC ENGINEERING			
CODE: 17PMIE41	HRS/WEEK: 6	HRS/SEM: 90	CREDITS: 4

## OBJECTIVES

To impart advanced level information in the subject of Genetic Engineering.

### UNIT - I

Gene cloning and vectors: Biology of vectors – Plasmids, bacteriophages, single stranded DNA vectors, cosmids, phasmids, specialized vectors – Plant viral vectors and other plasmid vectors –Animal viral vectors – Biology of host – *Escherichia coli* , *Saccharomyces cerevisiae* Cloning strategies: Cloning of genomic DNA, cDNA cloning and screening strategies.

### UNIT II

Enzymology of genetic engineering: Restriction enzymes – Types - Nomenclature – Recognition sequences – Cleavage patterns. Other enzymes used in Genetic engineering – DNA Ligase, Nuclease, Alkaline phosphatase, Kinase, Reverse transcriptase.

### UNIT-III

Recombinant techniques: Blotting techniques – Southern, Northern and Western Blotting – Transformation of *E.coli*- PCR –Probe construction- RFLP – AFLP – RAPD – SSCP and SNP- Construction of cDNA library – Molecular mapping of genome – Genetic and physical maps.

### UNIT- IV

Synthesis of commercial products by Recombinant microorganisms :Antibiotics, Biopolymers. Genetic engineering of bio-degradative pathways – Manipulation by Transfer of plasmids – by Gene Alteration.

### UNIT – V

Cloning in plants and animals – Transgenic plant (FlavrSavr Tomato) – Transgenic animal (Dolly) – GEM (Super bug) - Biotechnology and ethics – Biotechnology in Agriculture and Environment – Ethical aspects of genetic testing – Biowarfare.

## REFERENCE BOOKS

1. Bernard Glick; Jack J. Pasternak; Molecular Biotechnology: 2001 ASM press Washington 2<sup>nd</sup>Edn.
2. Brown, T.A. (1999). Gene Cloning. (3<sup>rd</sup> Edition). Chapman and Hall Publications, USA.
3. Burrell, M.M. (1993). Enzymes of Molecular Biology, Humana press.
4. Chirikjian, J.G. (1995). Biotechnology- Theory and Techniques. Vol.II, Jones and Burtlett Publishers.
5. Gerhardt, P., Murray, R.G., Wood, W.A., and Kreig, N.R. (1994). Methods for General and Molecular Bacteriology. ASM Press, Washington D.C.
6. Glick, B.R. and Pasternak, J. J. (1998) Molecular Biotechnology- principles and Applications of Recombinant DNA. ASM Press, Washington D.C.

7. Cafferty. Mc. J., Hoogenboom, H.R. and Chiswell, D.J. (1996) Antibody Engineering- A Practical Approach, Oxford University Press,
8. Lewin, B. (2000). Genes VII, Oxford University Press, Oxford.
9. Murray Moo Young (1992), Plant Biotechnology. Pergamon Press.
10. Radledge, C. and Kristiansen, B. (2001). Basic Biotechnology. (2<sup>nd</sup> Edition). Cambridge University Press.
11. Gupta. P.K. (1996). Elements of Biotechnology. Rastogi and Co., Meerut. India.
12. MukheshPasupuleti (2006). Molecular biotechnology. MJP Publishers, Chennai.
13. Dubey.R.C. (1996). A text of Biotechnology. S. Chand and Co Ltd. New Delhi.
14. Das. H.K. (2005). Text Book of Biotechnology. Wiley Dreamtech India (P) Ltd., New Delhi.
15. Rigby. P.W.J.Ed. (1987). Genetic Engineering. 6<sup>th</sup> Academic press, London.
16. Wiseman. A. (1983). Principles of Biotechnology. Chapman and Hall, New York.
17. Sathyanarayana.U. (2005). Biotechnology, Books and Allied (P) ., Kolkatta.
18. Desmond.S.T., Nicholl. (1994). An Introduction to Genetic Engineering Cambridge Press.



<b>SEMESTER – IV</b>			
<b>PRACTICAL –IV</b>			
<b>TECHNIQUES IN MICROBIAL GENETICS, MOLECULAR BIOLOGY, FOOD MICROBIOLOGY AND GENETIC ENGINEERING</b>			
<b>CODE: 17PMICR4</b>	<b>Hrs/week: 4</b>	<b>Hrs/Sem: 90</b>	<b>Credits: 2</b>

### **OBJECTIVES**

To impart advanced level practical training in Microbial Genetics, Molecular Biology, Food Microbiology and Genetic Engineering.

1. Molecular Biology: Isolation & Quantification of DNA from microorganisms.
2. Isolation of plasmid DNA
3. Agarose gel electrophoresis of DNA
4. Isolation of antibiotic resistant mutants by gradient plate technique
5. Mutagenesis: spontaneous mutation and isolation of UV induced mutants of *E.coli*.
6. Isolation of autotrophic mutants by Replica plating technique.
7. Ampicillin selection of auxotrophs
8. Microbial examination of milk i) Methylene blue reductase test ii) Resazurin test
9. Microbiological analysis of foods i) Vegetables ii) Meat iii) Fish
10. Isolation and identification of *Salmonella* in processed foods.
11. Enumeration of microorganism from bread
12. Portability test of water – MPN.
13. Wine production from grapes.
14. Mushroom cultivation.
15. Isolation of RNA from microorganisms.
16. Quantification of RNA by Orcinol method.
17. Quantification of DNA by DPA method.

### **REFERENCE BOOKS:**

1. Cappuccino. J.G., and Sherman. N. (1996). Microbiology – A Laboratory Manual. Benjamin Cummins. New York.
2. Kannan.N. (1996). Laboratory Manual in General Microbiology. Palani Paramount Publication, Palani.
3. Gunasekaran.P.(1996). Laboratory Manual in Microbiology. New Age International Ltd., Publishers, New Delhi.
4. Sundararaj, T. (2005), Microbiology – Laboratory Manual (1<sup>st</sup> Edition). Publn. Sundararaj.T, Chennai.
5. Palanivelu. P. Analytical Biochemistry and Separation Techniques.
6. Rajan.S.,Selvi Christy. R (2012).Experimental procedure in Life sciences. Book House.
7. Aneja.K.R., Experiments in Microbiology, Plant pathology and Biotechnology. Fourth Revised Edition. New Age International Publishers.