

## **MASTER OF SCIENCE IN MICROBIOLOGY REGULATIONS**

### **ELIGIBILITY**

A pass in any one of the following Degree Courses of B.Sc. Microbiology / Biotechnology / Biology / Botany / Zoology /Plant Science/ Animal Sciences / Biochemistry / Bioinformatics / Environmental Science / Food and Nutrition/ Clinical Lab Technology of any University in Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **M.Sc., Microbiology Examination** of this College after a course study of two academic years.

### **OBJECTIVE OF THE COURSE**

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To inculcate practical knowledge in correlation with the theoretical knowledge.
2. To equip the students to meet the requirements of the current technologies in Microbiology.
3. To motivate and train the students in various clinical and industrial sectors.
4. Involving the students in current issues in health care among the general public.

**SCHEME OF EXAMINATIONS**

Subject Code	Subject	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
<b>First Semester</b>							
15PMB13A	<b>PAPER- I:</b> FUNDAMENTALS OF MICROBIOLOGY	5	3	25	75	100	4
15PMB13B	<b>PAPER-II:</b> MICROBIAL DIVERSITY	5	3	25	75	100	4
15PMB13C	<b>PAPER-III:</b> MICROBIAL PHYSIOLOGY	5	3	25	75	100	4
15PMB13D	<b>PAPER- IV:</b> ANALYTICAL TECHNIQUES	5	3	25	75	100	4
15PMB13P	<b>PRACTICAL- I</b>	5	9	40	60	100	4
	<b>ELECTIVE- I</b>	5	3	25	75	100	4
		<b>30</b>				<b>600</b>	<b>24</b>
<b>Second Semester</b>							
15PMB23A	<b>PAPER- V:</b> ENVIRONMENTAL MICROBIOLOGY	5	3	25	75	100	4
15PMB23B	<b>PAPER -VI:</b> MICROBIAL GENETICS	5	3	25	75	100	4
15PMB23C	<b>PAPER -VII:</b> MOLECULAR BIOLOGY	5	3	25	75	100	4
15PMB23D	<b>PAPER- VIII:</b> IMMUNOLOGY	5	3	25	75	100	4
15PMB23P	<b>PRACTICAL -II</b>	5	9	40	60	100	4
	<b>ELECTIVE- II</b>	5	3	25	75	100	4
		<b>30</b>				<b>600</b>	<b>24</b>

*[Signature]*  
 BOS Chairman/HOD 29/7/2016  
 Department of Microbiology  
 Dr. N. G. P. Arts and Science College  
 Coimbatore – 641 048

*[Signature]*  
 Dr. P. R. MUTHUSWAMY,  
 PRINCIPAL  
 Dr. NGP Arts and Science College  
 Dr. NGP, Kalapatti Road  
 Coimbatore - 641 048  
 Tamilnadu, India

M.Sc-Microbiology (Students admitted from 2015-2016 onwards)

<b>Third Semester</b>							
15PMB33A	<b>PAPER- IX:</b> MEDICAL MICROBIOLOGY	5	3	25	75	100	4
15PMB33B	<b>PAPER -X:</b> BIOPROCESS TECHNOLOGY	5	3	25	75	100	4
15PMB33C	<b>PAPER-XI:</b> GENETIC ENGINEERING	5	3	25	75	100	4
15PMB33D	<b>PAPER -XII:</b> BIOETHICS AND IPR	5	3	25	75	100	4
15PMB33P	<b>PRACTICAL- III</b>	5	9	40	60	100	4
	<b>ELECTIVE- III</b>	5	3	25	75	100	4
		<b>30</b>				<b>600</b>	<b>24</b>
<b>Fourth Semester</b>							
15PMB43A	<b>PAPER- XIII: FOOD MICROBIOLOGY</b>	5	3	25	75	100	4
15PMB43B	<b>PAPER -XIV:</b> BIOSTATISTICS AND RESEARCH METHODOLOGY	5	3	25	75	100	4
15PMB43V	<b>PROJECT AND VIVA VOCE</b>	15	-	75	75	150	6
	<b>ELECTIVE- IV</b>	5	9	25	75	100	4
		<b>30</b>				<b>450</b>	<b>18</b>
<b>TOTAL</b>						<b>2250</b>	<b>90</b>

### ELECTIVE - I

(Student shall select any one of the following subject as Elective in first semester)

S.No	Subject Code	Name of the Subject
1.	15PMB1EA	Principles of Quality Assurance
2.	15PMB1EB	Diagnostic Microbiology

### ELECTIVE - II

(Student shall select any one of the following subject as Elective in Second semester)

S.No	Subject Code	Name of the Subject
1.	15PMB2EA	Pharmaceutical Quality Control
2.	15PMB2EB	Molecular Diagnostics

### ELECTIVE - III

(Student shall select any one of the following subject as Elective in Third semester)

S.No	Subject Code	Name of the Subject
1.	15PMB3EA	Microbial Food Technology and Food Quality Control
2.	15PMB3EB	Bioinformatics

### ELECTIVE - IV

(Student shall select any one of the following subject as Elective in Fourth semester)

S.No	Subject Code	Name of the Subject
1.	15PMB4EA	Total Quality Management
2.	15PMB4EB	Forensic Science

**Total Credit Distribution**

<b>Subjects</b>	<b>Credits</b>	<b>Total</b>		<b>Credits</b>	<b>Cumulative Total</b>
Core	4	14 x 100 =	1400	56	<b>68</b>
Core Lab	4	3 x 100 =	300	12	
Elective	4	4 x 100 =	400	16	<b>16</b>
Project	6	1 x 150 =	150	06	<b>06</b>
<b>Total</b>			<b>2250</b>	<b>90</b>	<b>90</b>

**FOR COURSE COMPLETION**

Students have to Complete the following Subjects:

- Core papers in I, II, III and IV Semesters.
- Elective papers in the I, II , III and IV Semesters.
- Core practical in I,II and III Semesters .
- Project and Viva - Voce in IV Semester.

<b>15PMB13A</b>	<b>PAPER -I: FUNDAMENTALS OF MICROBIOLOGY</b>	<b>SEMESTER - I</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Contributions of various scientists
2. Principles and applications of Microscope
3. Types of staining, sterilization, maintenance and preservation of cultures

### **CONTENTS**

#### **UNIT -I**

Basic concepts - Spontaneous generation- Germ theory of diseases - Cell theory - Contributions of Antony van Leuwenhoek - Joseph Lister - Robert Koch - Louis Pasteur - Edward Jenner - John Tyndall - Sergei N. Winogradsky - Salmon A. Waksman - Alexander Flemming - Paul Erlich - Fannie Hessie - Elie Metchnikoff. Development of Pure culture.

#### **UNIT- II**

Sterilization and disinfection - Definitions - Principles - Methods of sterilization -: Physical methods - Heat -Filtration - Radiation and Chemical methods. Phenol Co-efficient test. Control of sterilization and Testing of sterility.

#### **UNIT- III**

Microscopy - Principles, Light microscope, Phase Contrast, Dark field, Bright field, Fluorescent - Inverted microscope - Electron microscope - TEM, SEM. Stains and staining principles: Simple, Gram staining, Negative staining, Capsule staining, Spore staining, Flagellar staining and Acid fast staining.

#### UNIT- IV

Culturing of Bacteria - Pure culture Methods - Streak plate - Pour plate. Culture Media - Types of Media - Selective, Differential and Enriched Media. Cultivation of Anaerobes. Culture maintenance and Preservation. Culture Collection centers.

#### UNIT- V

Characteristics of Prokaryotic and Eukaryotic cells - Basic cell types: Prokaryotic cells - Size, shape and Arrangement - Overview of structure - Cell wall - Cell membrane - Internal membrane structure - Cytoplasm - Nucleoid - Inclusions - Endospores. External structure - Flagella and its function - Glycocalyx - Slime layer. Eukaryotic cells - Plasma membrane - Cytoplasm - Cell nucleus - Mitochondria and Chloroplast - Endoplasmic reticulum - Golgi apparatus - Lysosomes. External structures - Flagella - Cilia - Cell walls of Algae and Fungi.

#### TEXT BOOKS:

1. *Black, J.G.* 2013. **Microbiology**, 8<sup>th</sup> Edition. John Wiley and Sons.
2. *Prescott, L.M J.P. Harley and C.A. Klein* 1995. **Microbiology** 2<sup>nd</sup> Edition Wm, C. Brown Publishers.
3. *Salle A.J.* 1984. **Fundamental Principles of Bacteriology** 7<sup>th</sup> Edition, Tata Mc Hill Publishing Company Ltd.,
4. *Michael J. Pelczar, Jr. E.C.S. Chan,* 1986. **Microbiology**. Mc Graw Hill Book Company.

#### REFERENCE BOOKS:

1. *Micheal T Madigan.* **Brock Biology of Microorganisms**, 10<sup>th</sup> edition. Peareson Education.
2. *Edward I Alcamo,* 2000. **Fundamentals of Microbiology**, 6<sup>th</sup> Edition.

<b>15PMB13B</b>	<b>PAPER- II: MICROBIAL DIVERSITY</b>	<b>SEMESTER - I</b>
-----------------	---------------------------------------	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The course will impart knowledge on the

1. Phylogeny and Taxonomy of microbes
2. Bergey's manual and its importance
3. Diversity of Bacteria, Actinomycetes, Fungi, Algae, and Viruses

### **CONTENTS**

#### **UNIT- I**

Microbial systematic - Taxonomic ranks - Classification system - Phentic classification - Numerical taxonomy and Phylogenetic classification - Major characteristics used in taxonomy - Assessing microbial phylogeny - Major Division of Life. Whittaker's Five Kingdom concept. Bergey's manual (9<sup>th</sup> Edition) and its importance.

#### **UNIT- II**

Introduction to Archaea - Archaeal cell wall, lipids and membranes, Genetics and molecular biology, metabolism. Archaeal taxonomy - Outline characteristics of Phylum - Crenarchaeota and Euryarchaeota.

#### **UNIT- III**

Eubacteria - Photosynthetic bacteria - Spirochaetes - Bacteroidetes. Characteristics of major groups. Proteobacteria - Alpha protobacteria - Rhizobiales - Rickettsiales.  $\beta$  Proteobacteria - Neisseriales. Gamma proteobacteria - Enterobacteriales - Pseudomonadales - Vibrionales. Delta proteobacteria - Bdellovibrio and Desulfobivrio. General characteristics of Mollicutes - Low G+C gram positive bacteria - High G+C gram positive bacteria.



#### **UNIT- IV**

Fungi - Characteristics of fungi - Classification of Fungi - Ascomycetes (Saccharomyces) - Basidiomycetes (Agaricus) - Zygomycetes (Rhizopus) - Oomycetes (Allomyces) - Deuteromycetes (Penicillium). Algae - Classification and Properties of major groups of algae: Chlorophyta, Euglenophyta, Dinoflagellata, Crisophyta, Phaeophyta, Rhodophyta.

#### **UNIT -V**

Virus - Structure and General Properties - Symmetry - Genome - Enzymes in virions. Baltimore scheme of Classification of viruses. Bacterial viruses - Cyanophages - Eukaryotic viruses - Plant viruses - Animal viruses. Subviral agents - Viroid and Prions.

#### **TEXT BOOKS:**

1. *Michael Madigan*, 2015. **Brock Biology of Microorganisms**, 14<sup>th</sup> Edition. Pearson publishers.
2. *Prescott, L.M J.P. Harley and C.A. Klein*. 1995. **Microbiology** 2<sup>nd</sup> Edition Wm, C. Brown Publishers.

#### **REFERENCE BOOK:**

1. *Edward I Alcamo*, 2000. **Fundamentals of Microbiology**, 6<sup>th</sup> Edition.

<b>15PMB13C</b>	<b>PAPER- III: MICROBIAL PHYSIOLOGY</b>	<b>SEMESTER - I</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Nutritional requirements of microorganisms
2. Microbial growth and metabolism
3. Anaerobic respiration, fermentation and Photosynthesis

### **CONTENTS**

#### **UNIT-I**

Nutrition and Growth: Nutritional types of microorganisms - Phototrophs - Autotrophs - Lithotrophs - Organotrophs. Nutritional requirements. Environmental effects on Microbial growth - Temperature, pH, Pressure, Oxygen. Physiology of Growth - Growth curve. Growth measurements - batch, continuous and synchronous. Membrane transport - Diffusion, active and passive transport, group translocation, ion uptake.

#### **UNIT-II**

Enzymes and co -enzymes: IUBMB classification and nomenclature of enzymes, active site, Lock and key Mechanism and induced fit hypothesis, Enzyme kinetics- negative and Positive co-operatively, enzyme inhibition: Reversible - Competitive, Noncompetitive, uncompetitive and irreversible inhibition. Regulatory and Allosteric enzymes.

#### **UNIT-III**

General pathways of Carbohydrate metabolism: EMP pathway - Substrate level Phosphorylation - HMP Pathway - Entner Doudroff pathway - Glyoxalate pathway - Krebs cycle. Fermentations of carbohydrates - Homolactic - Mixed acid - Butane di ol - Propionic acid fermentation.  $\beta$  - Oxidation of Fatty acids. Energy production: Electron transport chain and Oxidative phosphorylation. Pasteur Effect. Bioluminescence.

#### UNIT-IV

Biosynthesis of aspartate, pyruvate, histidine and serine amino acid families - purine and pyrimidine nucleotides, denovo and salvage pathway. Biosynthesis of fatty acids. Biosynthesis of gram positive and gram negative cell wall.

#### UNIT-V

Photosynthesis and Inorganic metabolism: Characteristics and metabolism of Autotrophs - Photosynthetic bacteria and Cyanobacteria - Autotrophic CO<sub>2</sub> fixation and Mechanisms of Photosynthesis - Hydrogen bacteria - Nitrifying bacteria. Sulfur bacteria, Iron bacteria. Methylophs - Methanogens.

#### TEXT BOOKS:

1. *Moat. A.G. J.W.Foster.* 1988. **Microbial physiology.** 4th edition. John Wiley & sons.
2. *Gerhard Gottschalk,* 2006. **Bacterial Metabolism.** Springer-Verlag New York.
3. *David White and George D. Hageman.* 2000. **Microbial Physiology and Biochemistry Laboratory.** Oxford University Press.

#### REFERENCE BOOKS:

1. *Doelle. H.W.*1975.**Bacterial Metabolism.** 2nd edition. Academic Press.
2. *Geoffrey Michael Gadd,* 2008. **Bacterial Physiology and Metabolism,** Cambridge University Press.

<b>15PMB13D</b>	<b>PAPER- IV - ANALYTICAL TECHNIQUES</b>	<b>SEMESTER - I</b>
-----------------	--	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build knowledge on the analytical techniques used in the

1. Separation of Biomolecules
2. Purification of Biomolecules
3. Quantification of Biomolecules

### **CONTENTS**

#### **UNIT- I**

Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods

#### **UNIT -II**

Chromatography: Principles, Instrumentation, Types and Detection methods - Paper, TLC, HPLC, Ion-exchange, Column, Gel permeation, Chiral, Hydroxyapatite, Immuno adsorption and Affinity Chromatography - Applications, GC-MS.

#### **UNIT- III**

Colorimetry: Principles, Instrumentation and Applications- Beer Lamberts law - Analysis - Qualitative and Quantitative. Basic principles of Spectrophotometry: The laws of absorption, principles and instrumentation for UV- visible and IR spectroscopy. Principles, theory and applications of Spectrofluorometry and Flame photometry.

#### **UNIT -IV**

Electrophoresis - General Principles - support media - SDS - PAGE - Native gel - Gradient gel - Isoelectric focusing - 2D Page - Cellulose acetate electrophoresis - Detection, Estimation and Recovery of Proteins in gel - Western blotting - Electrophoresis of Nucleic acids - Agarose gel Electrophoresis - DNA sequencing gels - Pulse Field Gel Electrophoresis - Electrophoresis of RNA - Capillary electrophoresis - Microchip Electrophoresis.

#### **UNIT- V**

Radioisotopes - Nature of Radioactivity - Types of Radioactive decay - Rate of Radioactive decay - Units of Radioactivity - Interaction of Radioactivity with matter - Detection and Measurement of Radioactivity - based on Gas ionization - based on Excitation - based on Exposure of Photographic Emulsion - Safety aspects.

#### **TEXT BOOK:**

1. Sawhney S K, 2000. Introductory Practical Biochemistry, Narosa Publishing House.

#### **REFERENCE BOOKS:**

1. *Plummer.T David.* 2004. **An Introduction to Practical Biochemistry.** 3<sup>rd</sup> Edition, TMH Publishers.
2. *Terrance G Cooper,* 2010. **The tools of Biochemistry,** 2<sup>nd</sup> edition. John Wiley and sons.
3. *Rodney Boyer,* 2000. **Modern Experimental Biochemistry.** 3<sup>rd</sup> Edition, Pearson education Publishers.

<b>15PMB13P</b>	<b>PRACTICAL- I</b>	<b>SEMESTER - I</b>
-----------------	---------------------	---------------------

**Total Credits: 4**  
**Hours per week: 5**

## CONTENTS

1. Bacterial Staining techniques
  - a. Simple
  - b. Gram
  - c. Acid-fast
  - d. Spore
  - e. Capsule and
  - f. Negative.
2. Micrometry – Measurement of microorganisms.
3. Motility determination- Hanging drop and soft agar inoculation.
4. Enumeration of Microorganisms from soil: Bacteria, Fungi and Actinomycetes.
5. Fungal Mount – Wet mount and LCB Mount
6. Determination of Generation time - Direct microscopic and turbidity method
7. Effect of various intrinsic factors on the growth of bacterium and fungi - pH, Temperature
8. Anaerobic technique – Roll tube method
9. IMViC test
10. Hydrogen sulphide test
11. Oxidase test
12. Catalase test
13. Urease test
14. Polymer degradation – Starch, Gelatin, Casein.
15. Carbohydrate fermentation.
16. Preferential utilization of sugar – TSI
17. Quantitative determination of Sugar by DNSA method
18. Quantitative determination of Protein by Lowy *et al* method
19. Separation techniques: Chromatography- Paper, TLC and Column.

**LABORATORY MANUALS:**

1. *Kannan, N.* 1997. **Laboratory Manual of General Microbiology**, 1st edition, Panima Publishing house.
2. *Aneja. K.R.,* 2012. **Experiments in Microbiology, Plant Pathology and Biotechnology**, 2<sup>nd</sup> edition. New age publishers.

**REFERENCE BOOKS:**

1. *James.C.Cappuccino.* 2013. **Microbiology A laboratory manual**. 1st edition, Pearson education publishers.

<b>15PMB1EA</b>	<b>ELECTIVE- I: PRINCIPLES OF QUALITY ASSURANCE</b>	<b>SEMESTER - I</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Sustenance of reproductivity in microbiological labs
2. To understand the role of quality in diagnostic procedures
3. Understand the significance of sterility in labs

### **CONTENTS**

#### **UNIT- I**

Quality assurance – Introduction and overview – Definition. Designing of microbiology laboratory – Control of quality – Applications.

#### **UNIT- II**

Quality assessment of Equipments, chemicals, glass wares and laboratory environments – Variance – Quality control calculations – Quality management – Maintenance of records and reports.

#### **UNIT- III**

Quality assurance in sterilization and disinfection - Preservation of stock cultures, media and diagnostic kits – Quality control of media and stains.

#### **UNIT- IV**

Quality assessment of disposal – decontaminated matters and other biological effluents – Quality management in transportations of cultures. National control of biologicals – Biological references and standards.



## UNIT- V

Good laboratory practices - Management of laboratory hazards and knowledge in First aid procedures.

### TEXT BOOK:

1. *Rajesh Bhatia and Rattan Lal Ichhpujani*. 1995. I ed. **“Quality assurance in Microbiology”**

<b>15PMB1EB</b>	<b>ELECTIVE -I: DIAGNOSTIC MICROBIOLOGY</b>	<b>SEMESTER - I</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Collection and processing of clinical specimens.
2. Blood smear preparation and identification of blood cells.
3. Staining method and types of staining.

### **CONTENTS**

#### **UNIT- I**

Diagnostic Microbiology: Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections, Bacterial infections of respiratory tract. Bacterial infections of gastro intestinal tract and food poisoning.

#### **UNIT- II**

Bacterial urinary tract infections. Bacterial infections of genital tract and reproductive organs. Bacterial infections of central nervous system. Skin and soft tissue infections. Bone and joint infections, Eye ear and sinus infections, Cardiovascular infections. Anaerobic infections, Zoonotic infections. Infections associated with immunodeficiency and immune suppression, Pyrexia of unknown origin.

#### **UNIT- III**

Diagnostic parasitology : Systematic study of following parasites, laboratory diagnosis of Protozoa – Intestinal amoeba, free living pathologic amoeba, giardia, trichomonas, balantidium, isospora, cryptosporidium, microspora, cyclospora Plasmodia, leishmania, trypanasoma, toxoplasma, babesia.

#### **UNIT- IV**

Epidemiology, Pathogenesis, Laboratory Diagnosis of Fungal Infections. Specimen collection, preservation, Transportation & Identification of Mycological Agent. Biochemical tests for fungal identification, Anti fungal agents, invitro tests, Serological tests for mycotic infections, Use of laboratory animals in Mycology.

#### **UNIT -V**

Cultivation and purification of viruses, Principle and application of serodiagnostic methods - hemagglutination and haemagglutination inhibition tests, Complement fixation, neutralization, Western blot, RIPA, Flow cytometry and immunohistochemistry. Nucleic acid based diagnosis - Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing. Microscopic techniques - Fluorescence, confocal and electron microscopic techniques.

#### **TEXT BOOKS:**

1. *Elmer w koneman. Diagnostic Microbiology.* 5<sup>th</sup> edition. Jaypee brothers Medical Publishers..
2. *Barbara H. Estridge. Basic Medical laboratory techniques,* 4<sup>th</sup> edition. Delmar Thomson Learning.

#### **REFERENCE BOOKS:**

1. *Timbury. Medical Virology,* 11<sup>th</sup> edition, Churchill Livingstone..
2. *Jayaraman Panicker. Textbook of Medical Parasitology,* 6<sup>th</sup> edition. Jaypee brothers Medical publishers.
3. *Rajesh Karyakarte and Ajith Damle.* 1<sup>st</sup> edition. **Medical Parasitology,** books and Allied(P)Ltd

<b>15PMB23A</b>	<b>PAPER -V: ENVIRONMENTAL MICROBIOLOGY</b>	<b>SEMESTER - I</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Exploration and dissemination of micro flora in environment
2. To understand the role of microbes to better ecological niche
3. Understand the significance of microbes in environmental cleaning

### **CONTENTS**

#### **UNIT -I**

Aerobiology-Microbial contamination of air-Sources of contamination-Biological indicators of air pollution. Enumeration of bacteria from air, Air sampling devices. Significance of air Micro flora, Outline of Airborne diseases (Bacterial, Fungal and Viral), Air sanitation. Effect of Air pollution of plants and Humans.

#### **UNIT -II**

Soil Microbiology-Structure, Types, Physical and Chemical properties-Soil microbes (Types and Enumeration)-Weathering and Humus formation, Soil pollution-Sources. Biogeochemical cycling - Nitrogen, Carbon, Phosphorous, Sulphur, Iron cycles and its importance. Nitrogen fixation.

#### **UNIT -III**

Aquatic Microbiology-Microbiology of water (Aquatic environment-Fresh and Marine)-Water Pollution and Waterborne Pathogens. Assessment of water quality (Chemical and Microbial) Bacteriological examination of water-Indicator organisms. Microbiology of Sewage-Waste water treatment - BOD and COD.

#### **UNIT -IV**

Treatment of solid waste - Landfills - Composting. Treatment of Liquid waste - Biological Oxygen demand - Fixed film Sewage treatment systems - suspended cell sewage treatment systems - Tertiary treatments - Disinfection - Treatment and Safety of Water supplies - Water quality testing.

#### **UNIT -V**

Methods in Microbial Ecology - Culture dependent analysis of Microbial communities - Culture independent Microscopic analysis of Microbial communities - culture independent genetic analysis of Microbial communities - Measuring microbial activities in nature - Chemical radio isotopic and micro sensor methods.

#### **TEXT BOOKS:**

1. *Atlas R. M and Bartha.* 2005. **Microbial Ecology**, 4<sup>th</sup> edition. Pearson education.
2. *Michael Madigan,* 2015. **Brock Biology of Microorganisms**, 14<sup>th</sup> Edition. Pearson publishers.
3. *Alexander M.* 1977. **Introduction to soil microbiology**. John Wiley & Sons, Inc., New York.
4. *Gerhard Rheinheimer,* 1991. **Aquatic Microbiology**. 4<sup>th</sup> Edition. John Wiley and sons.

#### **REFERENCE BOOK:**

1. *Black, J.G.* 2013. **Microbiology**, 8<sup>th</sup> Edition. John Wiley and Sons.

<b>15PMB23B</b>	<b>PAPER -VI: MICROBIAL GENETICS</b>	<b>SEMESTER- II</b>
-----------------	--------------------------------------	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. To know the fundamentals behind origin of Modern Genetics
2. Bacterial genetic recombination
3. Genetic material exchange and mutations.

### **CONTENTS**

#### **UNIT -I**

History of Genetics. Darwin's theory of evolution, Neo-Darwinism, modern synthesis theory of evolution. Natural variation, sources of genetic variation. Chromosomes & crossing over. Sex-influenced and limited inheritance. Chromatin structure and organization.

#### **UNIT -II**

Mendel's Laws, concept of dominance, segregation, independent assortment; Chromosome theory of inheritance. Allelic and non-allelic interactions: Concept of alleles, types of dominance, lethal alleles, multiple alleles, test of allelism, complementation; X-linked inheritance (Chromosomal theory of inheritance).

#### **UNIT- III**

Genetic transfers in bacteria - Transformation - Transduction and Conjugation. Phage genetics, Phage T mutants, Genetic recombination, Genetic mapping of T-4 Phage.

#### **UNIT -IV**

Genetic code - Nature - Features: Codons, Anticodons, Universality, Overlapping, Non-overlapping, Redundancy. Mutation - types of Mutation - Biochemical basis of mutation - Mutagenesis - Base analogue mutagens -

Chemical mutagens - Mutagenesis by intercalating agents - Reversion. DNA repair mechanisms: Photo reactivation - Excision repair - Recombination repair - SOS repair.

#### **UNIT -V**

Regulation of gene activity - Operon model- positive and negative operon: (Lac, Trp), Autoregulation - translational regulation. Genome organization in viruses, prokaryotes and eukaryotes: Organization of nuclear and organellar genomes. C-value paradox.

#### **TEXT BOOKS:**

1. *Freidfelder, D.* 1995. **Microbial genetics**, 1<sup>st</sup> edition. Narosa Publishing House.
2. *Maloy, S.R.* 1989. **Microbial Genetics**, 2<sup>nd</sup> edition. Jones and Bartelt Publishers.

#### **REFERENCE BOOKS:**

1. *Klug .W.S. and Cummings, M.R.* 1996. **Essentials of Genetics**, Mentics Hail, NewJersey.
2. *Tamarin, Robert H.* 1999. **Principles of Genetics**, 5th edition, Cm Brown Publishers.
3. *Freifelder, S.* 1987 **Microbial Genetics**, 1<sup>st</sup> edition. Jones & Bartlett, Boston.

<b>15PMB23C</b>	<b>PAPER -VII: MOLECULAR BIOLOGY</b>	<b>SEMESTER- II</b>
-----------------	--------------------------------------	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Restriction enzymes and types
2. Isolation - Purification of DNA and RNA
3. Gene Transfer Techniques, Blotting Techniques, RFLP and application

### **CONTENTS**

#### **UNIT -I**

Historical introduction – DNA and RNA as genetic material – Duplex DNA. Chemical composition, Physical structures of DNA, Circular and Superhelical DNA. RNA- Structure and types.

#### **UNIT -II**

DNA Replication – Basic rule for replication of all nucleic acids - Geometry of DNA replication – Enzymology – Discontinuous replication – Events in the replication fork – Initiation of the synthesis of leading strand – Bidirectional replication – Termination of replication – Methylation of DNA and mismatch repair. Replication of Eukaryotic chromosomes – Eukaryotic DNA polymerases – Multiple forks in Eukaryotic DNA – Replication of Chromatin.

#### **UNIT- III**

Transcription – Enzymatic synthesis of RNA – Basic features of RNA synthesis – E. coli RNA polymerase – RNA chain initiation – Elongation – Termination and release of newly synthesized RNA. Transcription on Eukaryotes – Transcription unit concept. Eukaryotic rRNA genes – Formation of Eukaryotic tRNA molecules – small RNA molecules – RNA polymerases of Eukaryotes – Structure of 5' and 3' termini of Eukaryotic mRNA – RNA splicing – Splicing mechanisms.



#### UNIT- IV

Translation – Transfer of RNA and aminoacyl synthetases – The codon, anticodon interactions – Wobble hypothesis – Special properties of Prokaryotic initiator tRNA - Suppressors – Direction of polypeptide chain growth and translation mRNA – Initiation, Elongation and Termination in Prokaryotes – Post translational modifications of protein. Protein synthesis in Eukaryotes.

#### UNIT- V

Regulation in Eukaryotes – Regulation strategies in Eukaryotes – Gene alteration – Gene loss – Gene amplification – Gene rearrangement – regulation of synthesis of primary transcripts – regulation of processing – translational control.

#### TEXT BOOKS:

1. *Old. RW and Primrose, 1995. Principle of Gene Manipulation, 5th edition.* Blackwell Scientific Publication, Boston.
2. *Winnecker, E.D, 1987. From Gene to Clones, Introduction to Gene Technology, 1 st edition.* Panima educational book agency.
3. *David Freofelder, 1987. Molecular Biology, 2<sup>nd</sup> Edition.* Jones and Bartlett Publishers.

#### REFERENCE BOOKS:

1. *T.A Brown 1<sup>st</sup> edition, 2002. Genomes, John- Wiley & Son.*
2. *Glick B .R and Pasternak J .J .1994. Molecular Biotechnology. Principles and Application of recombinant DNA, 2 nd edition.* ASM Press, Washington.

<b>15PMB23D</b>	<b>PAPER- VIII: IMMUNOLOGY</b>	<b>SEMESTER- II</b>
-----------------	--------------------------------	---------------------

**Total Credits: 4**

**Hours per week: 5**

## **OBJECTIVES**

The subject aims to build the concepts regarding:

1. History of immunology and antigen -antibody types.
2. Hypersensitivity and immune response.
3. Blood grouping and transplantation.

## **CONTENTS**

### **UNIT -I**

Historical background and scope of immunology, Basis of Human Defence mechanisms: First line defence - Anatomical and physiological barriers - second line defence - Fever, inflammation, Phagocytosis and interferon - Third line defence. Cells and organs of immune system.

### **UNIT- II**

Immunity - types of immunity - Natural, acquired, specific and non specific, cell mediated and humoral, active and passive immunity. Antigens - properties, Epitopes, haptens, adjuvant, cross reactivity. Antibodies - properties, structure (primary & secondary) and isotypes. Diversity and specificity. Anti antibodies. Complement pathway.

### **UNIT -III**

Antigens and antibody reactions - Introduction and classification of antigens and antibody reactions - Agglutination and precipitation reaction. Strength of antigen and antibody bindings - affinity & avidity. Therapeutic applications of monoclonal antibodies. and complement fixation reaction. Immunofluorescence RIA, RAST, ELISA and Flowcytometry.

### **UNIT -IV**

Hyper sensitivity - Type I, II, III and IV - MHC antigens - types and functions. Response of B cell to antigens. T cell products. Immunity to infectious diseases - Viral, bacterial and protozoan.

## UNIT -V

Transplantation immunology - Tissue transplantation and grafting. Mechanism of graft acceptance and rejection. HLA typing Tumor immunology. Immunodeficiency diseases and auto immunity. Vaccines - Types and vaccination methods.

### TEXT BOOKS:

1. *Roitt, IM.* 2011. **Immunology** 1<sup>st</sup> edition. Mosby Publishers.
2. *Kuby.J.* 2002. **Immunology** 5<sup>th</sup> edition. W.H.Freeman, NY.

### REFERENCE BOOKS:

1. *Tizard, I R.* 1998. **Immunology an Introduction**, 4<sup>th</sup> edition. Thomson publishers, Australia.
2. *Kenneth Murphy.* 2011. **Janeway's Immunology**, 8<sup>th</sup> Edition. Garland Science Publisher.

<b>15PMB23P</b>	<b>PRACTICAL- II</b>	<b>SEMESTER-II</b>
-----------------	----------------------	--------------------

**Total Credits: 4**  
**Hours per week: 5**

1. Isolation of nitrogen fixers – free living and symbiotic
2. Isolation of Phosphate solubilizers.
3. Isolation of Coli phage.
4. Decolorisation of dyes and dye containing effluents.
5. Determination of DO, BOD, COD
6. Isolation of Auxotrophic mutants
7. Isolation of Antibiotic resistant mutants
8. Extraction of Plasmids and chromosomal DNA from microbes.
9. Separation of nucleic acids and proteins
10. Identification and enumeration of Lymphocytes.
11. Isolation and characterization of antigens
12. Animal handling, Marking, Bleeding and Immunization
13. Serological tests: Blood grouping, Widal, VDRL
14. Immunoelectrophoresis
15. Ouchterlony's immunodiffusion

#### **LAB MANUALS:**

1. *Kannan N., Laboratory Manual of General Microbiology, 2<sup>nd</sup> edition.* Panima Publishing House.
2. *Aneja. K.R. 2012. Experiments in Microbiology, plant pathology and biotechnology, 4<sup>th</sup> Edition.* New age publishers.

15PMB2EA	<b>ELECTIVE- II: PHARMACEUTICAL QUALITY CONTROL</b>	<b>SEMESTER- II</b>
----------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Sterility in pharmaceutical products
2. Need of a qualified microbiologist and his role in Pharma Industry
3. Validation and its importance in expiry of medicines

### **CONTENTS**

#### **UNIT- I**

An introduction to pharmaceutical microbiology. Chemical growth control. Chemical antimicrobial agents for external use, synthetic antimicrobial drugs, naturally occurring antimicrobial drugs: Antibiotics. Antibiotics from prokaryotes, antiviral drugs, antifungal drugs, antimicrobial drug resistance, the search for new antimicrobial drugs.

#### **UNIT- II**

Types of spoilage, Factors affecting microbial spoilage – assessment of microbial spoilage – preservation. Ecology of microorganisms as it affects the pharmaceutical industry – Sterile pharmaceutical products – injections, Non injectable sterile fluids, Ophthalmic preparations, dressings & implants.

#### **UNIT- III**

Sterilization control - methods of sterility testing- sterilization monitors and Quality assurance of products. The microbiological quality and regulatory requirements for natural and nutraceutical products, The regulatory control and quality assurance of immunological products, Containment system integrity – sterile products, Regulatory guidelines (microbiology) for veterinary antimicrobial products.

#### **UNIT- IV**

The role of the Qualified Person in microbiological quality assurance, Safety in microbiology, Rapid enumeration and identification methods, Selection and use of cleaning and disinfection agents in pharmaceutical manufacturing, Prevention and elimination of microbial biofilms in the manufacturing environment using Clean-in-Place, Cleanroom design, operation and regulatory standards.

#### **UNIT -V**

Microbiological quality assurance. Validation of aseptic processing and media fills, International disinfectant testing protocols, Measurement of biocide effectiveness, Microbiological quality and regulatory requirements for biotherapeutics and manufactured products, The role of the microbiologist in HACCP, Auditing the pharmaceutical microbiology department.

#### **TEXT BOOK:**

1. *W.B.Hugo & A.D.Russel*, 2007. **Pharmaceutical Microbiology**, 4<sup>th</sup> Edition, Blackwell Scientific Publications.

#### **REFERENCE BOOKS:**

1. *Dr Norman Hodges and Professor Geoff Hanlon* (University of Brighton), 2013. **Industrial Pharmaceutical Microbiology - Vol I & Vol II: standards & Controls**.
2. *Madigan M.T.* 2006. **Brock Biology of Microorganisms** 11<sup>th</sup> Edition. Pearson-Prentice Hall, USA.

<b>15PMB2EB</b>	<b>ELECTIVE- II: MOLECULAR DIAGNOSTICS</b>	<b>SEMESTER- II</b>
-----------------	--	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Molecular based methods in diagnosis
2. Vaccines and Gene therapy
3. Diagnosis of genetic disorders

### **CONTENTS**

#### **UNIT- I**

Identification of human bacterial pathogens by Polymerase chain reaction - PCR based diagnosis of plant bacterial pathogen - Culture independent analysis of microbes by DGGE and TRFLP.

#### **UNIT- II**

Detection of viral infections in shrimp by PCR - Molecular detection and characterization of DNA virus - Hepatitis B virus - Molecular diagnosis of Human Immunodeficiency virus (HIV) by RT- PCR - Molecular diagnosis of Human Immunodeficiency virus (HIV) by Western Blotting.

#### **UNIT -III**

Genotypic characterization of fungal pathogens - Molecular diagnosis of parasitic disease - Application of RAPD in plant breeding.

#### **UNIT- IV**

Amplification of Short Tandem Repeats (STR)/Microsatellites - Multiplex STR PCR - Single strand conformation polymorphism (SSCP) analysis - HLA typing and tissue transplantation matching - Microarrays for pathogen detection and SNP studies.

## UNIT-V

Molecular Diagnosis of human genetic disorders- Beta thalassemia - Checking of p53 gene polymorphism for - susceptibility to cancer , Down's Syndrome, Retinitis pigmentosa , Human identification and paternity determination by VNTR Probes.

### TEXT BOOKS:

1. *Sambrook, J., Russell, D.W.*, 2001. **Molecular Cloning: Laboratory Manual**. CSHL Press.
2. *Old, RW and Primrose, 1995* **Principle of Gene Manipulation**, 5th edition. Blackwell Scientific Publication, Boston.
3. *Winnecker, E.D*, 1<sup>st</sup> edition **From gene to clones, Introduction to Gene Technology**, VCH Publication, FRG.
4. *T.A Brown* 1995, 3<sup>rd</sup> edition, **An Introduction to Gene Cloning** ,Chapman and Hall.

### REFERENCE BOOKS:

1. *Glick B .R and Pasternak J .J* ,**Molecular Biotechnology. Principles and Application of recombinant DNA**, ASM Press ,Washington
2. *Cann. A*. **Principles of Molecular Virology**. 3<sup>rd</sup> edition. Academic Press.
3. *Mary Shuler*. **Methods in Plant molecular biology**. 1<sup>st</sup> edition. Academic Press.



15PMB33A	PAPER -IX: MEDICAL MICROBIOLOGY	SEMESTER- III
----------	---------------------------------	---------------

Total Credits: 4  
Hours per week: 5

### OBJECTIVES:

The subject aims to build the concepts regarding:

1. Gram positive organisms and Gram negative organisms
2. Viral diseases and its diagnosis
3. Mycology, Parasitology, antibiotics and chemotherapeutic agents

### CONTENTS

#### UNIT-I

Introduction to medical microbiology - Infectious Diseases process - Diagnosis: Collection of clinical samples, transport and examination, Antibiogram and serological test.

#### UNIT-II

Bacteriology: Gram positive organisms - Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pneumococcus*, *Bacillus anthracis*, *Corynebacterium diphtheriae*, *Clostridium tetani*, *Clostridium botulinum*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Spirochaetes* - *Treponema pallidum* and *Leptospira icterohaemorrhagiae*.

#### UNIT-III

Bacteriology: Gram negative organisms:- Morphology, cultural characteristics, pathogenicity and laboratory diagnosis of *E.coli*, *Klebsiella sp*, *Salmonella typhi*, *Shigella dysenteriae*, *Pseudomonas aeruginosa*, *Vibrio cholerae*, *Bordetella pertusis*, *Yersinia pestis* and *Neisseria gonorrhoea* , *Neisseria meningitidis*.

#### UNIT-IV

Virology: Basic concepts of virology - General properties of Human viruses, Approaches to viral diagnosis- Serological and Molecular techniques,

Pathogenicity and Laboratory diagnosis of viral infections - Hepatitis, Polio, Rabies, Influenza, Measles, Mumps, Rubella, Dengue virus and HIV.

## UNIT-V

Mycology : General properties and approaches to laboratory diagnosis. Mycosis – Superficial, Subcutaneous and Systemic infections – *Cryptococcosis*, *Madura mycosis*, *Histoplasmosis*, *Candida albicans*, *Aspergillosis*.

Parasitology: Pathogenicity and laboratory diagnosis of *Entamoeba histolytica*, *Trichomonas vaginalis*, *Plasmodium vivax*, *Leishmania donovani*, *Wucheraria bancrofti*, *Taenia solium*.

## TEXT BOOKS:

1. *Patrick.K.Murray*. 2012. 4<sup>th</sup> edition. **Medical Microbiology**. Mosby Publishers.
2. *Ananthanarayanan R and CK Jayaram Panicker*, 2005. 2<sup>nd</sup> edition. **Introduction to Medical Microbiology** Orient Longman.
3. *CK Jayaram Paniker*. 2007. **Medical Parasitology**, 6<sup>th</sup> Edition. Jaypee Brothers Medical Publishers (p) Ltd. New Delhi.

## REFERENCE BOOKS:

1. *Bailey and Scotts*, 1994, **Diagnostic Microbiology**, 9<sup>th</sup> edition, Baron and Finegold CV Mosby Publications.
2. *Jawetz E Melnic JL and Adel berg EA* 1998, **Review of Medical Microbiology**. Lange Medical Publications, USA.
3. *Thomas Jones Mackie and James Elvins Mc Cartney*. 1996. **Mackie & McCartney Practical Medical Microbiology**, 14<sup>th</sup> Edition. Churchill Livingstone.

<b>15PMB33B</b>	<b>PAPER -X: BIOPROCESS TECHNOLOGY</b>	<b>SEMESTER- III</b>
-----------------	--	----------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

1. Fermentation- Definition & types
2. Industrial scale Production of beverages, Single cell protein
3. Downstream process

### **CONTENTS**

#### **UNIT- I**

An introduction to Fermentation Process. The range of Fermentation Process (Microbial biomass, Enzymes, Metabolites, Recombinant products, Transformation processes). Component parts of Fermentation process. Fermentor Design and Construction, Fermentor types - Bioreactors for Aerobic fermentation, Stirred bioreactors, Reactors for immobilized cells, Heat exchange, Stirring and Mixing, Gas exchange and Mass transfer.

#### **UNIT- II**

Industrially important Microorganisms. Isolation (Primary and Secondary screening), Preservation and Strain improvement (Mutation, Recombination, Regulation, Gene technology and Use of Genetic methods).

#### **UNIT- III**

Upstream processing-Development of Inoculum for Fermentation process- Media for Industrial Fermentation - Formulation, Optimization and Sterilization, Various stages in Upstream (Inoculum preservation, Growth of the inoculum, Fermenter preculture and Production fermentation).

#### **UNIT- IV**

Fermentation Types and Cultures -Batch, Continuous, Fed-batch, -Basic Growth Kinetics- Submerged and Solid state Fermentation -Downstream Processing-Recovery and Purification of Intracellular and Extracellular Products (Flocculation, Flotation, Filter systems, Centrifugation, Disintegration, Chromatography, Extraction, Crystallization, Precipitation and Drying).

## UNIT- V

Microbial production of Organic acids (Citric and Acetic) Enzymes (Amylase and Protease) Aminoacids (Lysine and Glutamic acid), Antibiotics (Penicillin, Streptomycin and Griseofulvin), Vitamins ( Riboflavin, Cyanocobalamine and Ascorbic acid)-Biosynthesis of Ergot alkaloids-Microbial transformation-Steroids and Sterols, Non-steroid compounds, Antibiotics and Pesticides.

### TEXT BOOKS:

1. *Crueger W and Crueger A.* 1991. **Biotechnology. A textbook of Industrial Microbiology.** Sinauer Associates Inc.,U.S.
2. *Stanbury P T and Whitaker* 1984. **Principles of Fermentation Technology,** 1str Edition. Adithya Books pvt ltd.

### REFERENCE BOOKS:

1. *Pepler. H.J.* 1997. 2 nd edition. **Microbial Technology.** Microbial Processes. Vol I & II. Academic Press.
2. *Demain A.J. and Solomon INA,* 1999. 2nd edition. **Manual of Industrial Microbiology and Biotechnology.**ASM press.

<b>15PMB33C</b>	<b>PAPER- XI: GENETIC ENGINEERING</b>	<b>SEMESTER- III</b>
-----------------	---------------------------------------	----------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Cloning and its requirements
2. Availability of different kinds of vectors
3. Fermented food and food borne diseases
4. Characterization of cloned DNA

### **CONTENTS**

#### **UNIT- I**

Cloning: Isolation and purification of nucleic acids (chromosomal DNA, RNA & Plasmids) - Methods of handling and quantification of DNA and RNA. Restriction endonucleases - types and characteristics - DNA methylases - Ligases - Adapters, Linkers and Homo and Hetero polymer tailing.

#### **UNIT- II**

Vectors - properties - types of vectors - plasmids- host range and incompatibility - Vectors constructed based on bacteriophages (M13 & Lambda), cosmids, phasmids, phagemids and BACs - Eukaryotic vectors - Yeast vectors (YAC) - animal (retroviruses, adenoviruses) and plant vectors (Ti plasmid based vectors and caulimoviral vector) - expression vectors - shuttle vectors.

#### **UNIT- III**

Screening: Direct: Insertional inactivation, plaque phenotype and indirect methods: Immunochemical detection - Nucleic acid hybridization, Blotting - Dot and Colony Blotting. Chromosome walking.

#### UNIT- IV

Characterization of cloned DNA: Restriction mapping - restriction fragment length polymorphism (RFLP) - Polymerase chain reaction (PCR) - Types of PCR and their applications. DNA sequencing: Primer walking, Maxim and Gilbert method, dideoxy method, automated sequencing and micro array. Protein Engineering. Genomic DNA libraries - cDNA libraries.

#### UNIT- V

Plant Genetic Engineering: Transformation with the Ti plasmid of *Agrobacterium tumefaciens* - Ti plasmid derived vector systems - Micro projectile Bombardment. Animal Genetic Engineering: Methodology for gene transfer - Application of transgenic mice.

#### TEXT BOOKS:

1. *Old. RW and Primrose*, 1995. **Principle of Gene Manipulation**, 5th edition. Blackwell Scientific Publication, Boston.
2. *T.A Brown* 1<sup>st</sup> edition, 2002. **Genomes**, John- Wiley & Son.

#### REFERENCE BOOKS:

1. *Winnecker, E.D*, 1987. **From Gene to Clones**, Introduction to Gene Technology, 1 st edition. Panima educational book agency.
2. *Glick B .R and Pasternak J .J* .1994. **Molecular Biotechnology. Principles and Application of recombinant DNA**, 2<sup>nd</sup> edition. ASM Press, Washington.

<b>15PMB33D</b>	<b>PAPER -XII: BIOETHICS AND IPR</b>	<b>SEMESTER- III</b>
-----------------	--------------------------------------	----------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to make students

1. To learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products.
2. To understand and follow the regulatory framework important for the product safety and benefit for the society.
3. To emphasize on IPR issues and need for knowledge in patents in biotechnology

### **CONTENTS**

#### **UNIT- I**

Introduction to Bioethics. Bioethics: Value of life Professional ethics in Microbiology and Biotechnology. Legal and socio-economic impact of biotechnology. Public education of the process of biotechnology involved in generating new forms of life for informed decision making. Biosafety regulation - National and International guidelines, r-DNA guidelines.

#### **UNIT- II**

Basic philosophies of animal ethics: (3 'R's), Animal Ethics Committee, executive, meetings, confidentiality and indemnity, period of approval, joint animal ethics committee, process to establish an AEC, guidelines for ethical conduct in the care and use of animals. Social responsibility for clinical researcher.

#### **UNIT- III**

Experimental protocol approvals, levels of containment, Environmental aspect of biotech- applications. Use of genetically modified organism and their release in environment Special procedures for r-DNA based product production.

#### UNIT- IV

Intellectual property rights. The World Trade Organization and the TRIPS agreement, the evidence about the impact of IP, Technology Transfer, Contracts and Agreements. International conventions patents and methods of application of patents

#### UNIT- V

Legal implications, biodiversity and farmers right. Beneficial application and development of research focus to the need of the poor. Identification of directions for yield effect in agriculture, aquaculture. Patenting living organisms.

#### TEXT BOOKS:

1. *Sasson A*, 1988. **Biotechnologies and Development**, UNESCO Publications.
2. *Sasson A*. 1993. **Biotechnologies in developing countries present and future**, UNESCO publishers.
3. *David Bainbridge*, 2012. **Intellectual Property**, 9<sup>th</sup> edition. Pearson Longman.

#### REFERENCE BOOKS:

1. *Singh, Kshitij Kumar*. 2014. **Intellectual Property Rights on Biotechnology**, 1<sup>st</sup> edition. Springer Publications, New Delhi.
2. *Shaleesha A. Stanley*, 2008. **Bioethics**, 1<sup>st</sup> edition. Wisdom educational service.
3. *Beier, F.K., Crespi, R.S. and Straus, T*. 1985. **Biotechnology and Patent protection**, 1<sup>st</sup> edition. Oxford and IBH Publishing Co.



15PMB33P	PRACTICAL - III	SEMESTER -III
----------	-----------------	---------------

Total Credits: 4

Hours per week: 5

## CONTENTS

### Diagnostic microbiology:

1. Isolation and identification of clinical pathogens - *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Salmonella*, *Shigella*, *Klebsiella*, *Proteus*, *Pseudomonas*.
2. Isolation and identification of clinically important fungi- *Candida albicans*, *Aspergillus sp.*,
3. Antibiotic susceptibility test. - Kirby Bauer technique and Stokes method Observation of permanent slides - *Entamoeba histolytica*, *Trichomonas vaginalis*, *Plasmodium vivax*, *Leishmania donovani*.
4. Wine production
5. Organic acid production - Citric acid - Solid state and submerged fermentation.
6. Production of Extra cellular enzymes - Protease by submerged fermentation
7. Cellulase by Solid state fermentation.

### LAB MANUALS:

1. Aneja. K.R. 2012. **Experiments in Microbiology, plant pathology and biotechnology**, 4<sup>th</sup> Edition. New age publishers.
2. James.C.Cappuccino. 2013. **Microbiology A laboratory manual**. 1st edition, Pearson education publishers.
3. Kannan,N. 1997. **Laboratory Manual of General Microbiology**, 1st edition, Panima Publishing House

<b>15PMB3EA</b>	<b>ELECTIVE -III: MICROBIAL FOOD TECHNOLOGY AND FOOD QUALITY CONTROL</b>	<b>SEMESTER -III</b>
-----------------	--	----------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Food and microorganisms
2. Food preservation and spoilage of food
3. Fermented food and food borne diseases

### **CONTENTS**

#### **UNIT- I**

Principles of Food preservation - Asepsis - Anaerobic conditions - Preservation by use of high temperature - Preservation by use of low temperature - Preservation by drying - Preservation by food additives - Preservation by Radiation.

#### **UNIT- II**

Indicator organisms - Direct examination - culture techniques - enumeration methods - plate - Viable & Total Count; Alternative methods - Dye reduction tests , electrical methods , ATP determination: Rapid methods, immunological methods - DNA / RNA methodology - laboratory accreditation.

#### **UNIT- III**

Investigation of Food borne disease outbreaks - Objectives of investigation - Materials and equipments required - The field investigations - Laboratory testing - Interpretation and applications of results - Preventive measures.

#### **UNIT- IV**

In house Committee for quality assurance, Persons involved, Internal Microbial Quality control Policy, Quality Check at every step from collection of raw materials till it reaches the customer , Implementation of ISO standards and history, definitions, principles and use of HACCP in Food Industry .

## UNIT -V

Food laws and regulations

A. National – PFA Essential Commodities Act (FPO, MPO etc.)

B. International – Codex Alimentarius, ISO – 9000 series , ISO 22000 & BS 5750.

C. Regulatory Agencies – WTO

Consumer Protection Act - Relevance of Microbiological standards & criteria for food safety – Sampling plans – Microbiological guidelines.

Hygiene and sanitation in food sector:

General Principles of Food Hygiene, GHP for commodities, equipment, work area and personnel, cleaning and disinfection (Methods and agents commonly used in the hospitality industry), Safety aspects of processing water (uses & standards) and Waste Water & Waste disposal

### TEXT BOOKS:

1. **James. M. Jay**, 1<sup>st</sup> edition. **Modern food microbiology**. CBS Publishers.
2. *Frazier. W.C and D.C Westhoff*. 1978. **Food Microbiology**. 3<sup>rd</sup> ed. Tata Macgraw Hill publishing Co., New Delhi.

### REFERENCE BOOKS:

1. *Jay, J.M* .1991. **Modern Food Microbiology** 4<sup>th</sup> edition, Van Nostra and Rainhokdd Co.
2. *Adams M.R. and Moss M. O.*, 2000. **Food Microbiology** 2<sup>nd</sup> edition. Panima Publishers.
3. Roger.Y.Stainer. Basic Food Microbiology. 2<sup>nd</sup> edition, CBS Publishers.

<b>15PMB3EB</b>	<b>ELECTIVE -III: BIOINFORMATICS</b>	<b>SEMESTER III</b>
-----------------	--------------------------------------	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Scope and Importance of Bioinformatics
2. Databases and its uses
3. Pharmacological informatics

### **CONTENTS**

#### **UNIT- I**

History, scope and importance - Important contributions - sequencing development - aims and tasks of Bioinformatics - applications of Bioinformatics - challenges and opportunities - Computers and programs - internet - world wide web - browsers - EMB net - NCBI.

#### **UNIT- II**

Databases - tools and their uses - Importance of databases - nucleic acid sequence databases - protein sequence data bases - structure databases - bibliographic databases and virtual library - specialized analysis packages

#### **UNIT- III**

Sequence alignment methods - Sequence analysis of biological data- models for sequence analysis and their biological motivation- methods of alignment - methods for optimal alignments; using gap penalties and scoring matrices- multiple sequence alignment - introduction - tools for MSA - application of multiple sequence alignment.

#### **UNIT- IV**

Predictive methods using DNA and protein sequences - Gene predictions strategies - protein prediction strategies - molecular visualization-Homology - phylogeny and evolutionary trees - Homology and similarity - phylogeny and relationships.

## UNIT- V

Drug discovery and Pharminformatics - Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

### TEXTBOOKS:

1. S.C. *Rastogi*, 2003. **Bioinformatics- Concepts, Skills, and Applications**, CBS Publishing.
2. S. *Ignacimuthu, S.J.*, 1995. **Basic Bioinformatics**, Narosa Publishing House, 1995.

### REFERENCES BOOKS:

1. *T K Attwood, D J parry-Smith*, 2005. **Introduction to Bioinformatics**, 1<sup>st</sup> Edition. Pearson Education.
2. *C S V Murthy*, 2003. **Bioinformatics**, Himalaya Publishing House, 1<sup>st</sup> Edition.
3. *Stephen A. Krawetz, David D. Womble*, 2003. **Introduction to Bioinformatics**. A Theoretical and Practical Approach, Humana Press.
4. Hooman H. Rashidi, Lukas K. Buehler, 2005. **Bioinformatics Basics-Applications in Biological Science and Medicine**, CRC press, 2005.

<b>15PMB43A</b>	<b>PAPER- XIII: FOOD MICROBIOLOGY</b>	<b>SEMESTER- III</b>
-----------------	---------------------------------------	----------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. Food and microorganisms
2. Food preservation and spoilage of food
3. Fermented food and food borne diseases
4. Rapid assessment of dairy food for microbial and non-microbial contaminants

### **CONTENTS**

#### **UNIT- I**

Food as a substrate - Factors influencing the growth of Microorganisms - Role of Microorganisms in Food microbiology - General characteristics, classification and importance of Mold, Yeast and Bacteria.

#### **UNIT- II**

Contamination and Spoilage of Foods - Fitness or unfitness of food for consumption - Classification of Foods by ease of spoilage - Factors affecting kinds and numbers of microorganisms in food - Chemical changes caused by microorganisms.

#### **UNIT- III**

Contamination, spoilage and preservation of Cereals and cereal products, sugar and sugar products, vegetables and fruits.

#### **UNIT- IV**

Contamination, spoilage and preservation of meat and meat products, fish and seafood, Eggs and poultry, Milk and Milk products and Canned foods.

## UNIT- V

Food poisoning - Food borne diseases - Salmonellosis, Shigellosis and Hemorrhagic colitis. Food intoxication - *Staphylococcus aureus*, *Clostridium perfringens*, *Bacillus cereus* and Mycotoxins.

Fermented foods - Meat and fishery products - Country cured hams, Dry sausages. Fermented milk products - Yoghurt, Cheese, Kefir, and Koumiss.

### TEXT BOOKS:

1. *Frazier. W.C and D.C Westhoff.* 1978. **Food Microbiology.** 3<sup>rd</sup> ed. Tata McGraw Hill publishing Co., New Delhi.
2. *Jay, J.M .*1991. **Modern Food Microbiology** 4<sup>th</sup> edition, Van Nostra and Rainhokdd Co.

### REFERENCE BOOKS:

1. *Adams. M. R and M. D Moss.*2007. **Food Microbiology,** 2<sup>nd</sup> edition. Panama Publishers.
2. *Roger.Y.Stanier.* 1987. **Basic Food Microbiology.** 2<sup>nd</sup> edition, CBS Publishers.

<b>15PMB43B</b>	<b>PAPER -XIV: BIOSTATISTICS AND RESEARCH METHODOLOGY</b>	<b>SEMESTER- IV</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

### **OBJECTIVES:**

The subject aims to build the concepts regarding:

1. To enrich mathematical aptitude
2. To solve various problems in bioscience which helps the students to do research problems
3. On successful completion of this course the students will be enriched in statistical tools.

### **CONTENTS**

#### **UNIT- I**

Definition – Scope of Biostatistics, Probability analysis, Variables in Biology- Collection, Classification and Tabulation of data. Graphical and diagrammatical representation -Scale diagram - Histogram- frequency curve.

#### **UNIT- II**

Measures of central tendency- Arithmetic mean, Median, Mode. Calculation of Mean, median, Mode in series of individual observations, discrete series, continuous, open end classes, measure of dispersion, standard deviation, standard error.

#### **UNIT- III**

Simple correlation coefficient of correlate regression- simple and linear regression. Basic ideas of significant test-Hypothesis testing, Level of significant test, test based on studies-t-test- chi square, Goodness of fit.

#### **UNIT- IV**

Basic ideas of significant test-Hypothesis testing, Level of significant test, test based on studies-t-test- chi square, Goodness of fit.



## UNIT- V

Selection of research problem – Formulation of research objectives - project design - review of literature writing - Sources of data collection for biosciences research - processing of data - presentation of data - editing - preparation of master's thesis. Presenting the research findings in open defense.

### TEXT BOOK:

1. *S. P. Gupta*.2009. Specifications of Statistical methods, 28<sup>th</sup> Edition. Sultan Chand & sons.

### REFERENCE BOOKS:

1. *Khan and Knanum*. 1994. Fundamentals of Biostatistics, Ukaaz Publications.
2. *C. R. Kothari*, 2004. **Research Methodology: Methods and Techniques**, New Age International.
3. *Martin. M.W. and Schinzinger.R.* 2003. **Ethics in engineering**, III Edition, Tata McGraw- Hill, New Delhi.

<b>15PMB4EA</b>	<b>ELECTIVE- IV: TOTAL QUALITY MANAGEMENT (TQM)</b>	<b>SEMESTER -IV</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

**OBJECTIVE:**

The subject aims:

1. To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management.
2. To understand the statistical approach for quality control.
3. To create an awareness about the ISO and QS certification process and its need for the industries.

**CONTENTS**

**UNIT - I**

Concepts in TQM - Tools & techniques of TQM - Requirements for implementing TQM - Steps for implementing TQM - Questionnaire, Assessment through questionnaire - Mission statement - Benefits of TQM - Check list for implementing TQM - Case study.

**UNIT -II**

Types of Data, tabular and Graphical summarization of numeric data: - Histograms & Stem and Leaf displays: Graphs for categorical data - Bar, Pie charts & Pareto diagrams.

**UNIT - III**

Graphs for time ordered data - Run charts, Cause & effect diagrams - Check Sheets. Check Sheets and Histograms; Quality Function Deployment; QFD - Team; Design of Experiments; Control Charts; Quality Management Systems; Bench Marking.

Graphic display of numeric summaries:-The box plot and the scatter diagram. Skewness, T - test, Anova,

#### UNIT - IV

Numeric data summarization - The mean, mode & Median; Standard deviation- Phases and Defective Units of Six Sigma, Variance, Range & Percentiles.

#### UNIT - V

Introduction to IS/ISO 9004:2000 - quality management systems - guidelines for performance improvements. Quality Audits.TQM culture, Leadership - quality council, employee involvement, motivation, empowerment, recognition and reward.

#### TEXT BOOKS:

- 1 *Ram Narain*. 2006. **Twelve Management skills for success**, 1<sup>st</sup> edition. Viva books private limited, Chennai.
- 2 *Ashok Rao, Lawrence P. Carr, Ismael Dambolena, Robert J. Kopp, John Martin, Farshad Rafii, Phyllis Fineman Schlesinger*, 1996. **Total Quality Management: A cross functional perspective**, 1<sup>st</sup> edition. John Wiley & Sons, New York.

#### REFERENCE BOOKS:

- 1 *Besterfield, Dale H. Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield-Sacre* **Total Quality Management**, 3<sup>rd</sup> edition. Prentice Hall Publishing House.
- 2 *Logothetis, N.*1993. **Managing for Total Quality**, 1<sup>st</sup> edition. Prentice Hall of India Private Limited
- 3 *Janakiraman, B and Gopal, R.K*, 2006. **Total Quality Management-Text and Cases**, 1<sup>st</sup> edition. Prentice Hall (India) Pvt. Ltd.,

<b>15PMB4EB</b>	<b>ELECTIVE -IV: FORENSIC SCIENCE</b>	<b>SEMESTER -IV</b>
-----------------	---	---------------------

**Total Credits: 4**  
**Hours per week: 5**

**OBJECTIVE:**

1. Basics of Forensic Science
2. Role of Biological sciences in Forensic Science
3. Applications of Biological techniques in Forensic science

**UNIT-1**

Definition of Forensic Science, Scope of Forensic Science, Need of Forensic Science, Basic Principles of Forensic Science, Tools and Techniques of Forensic Science. Ethics in Forensic Science, Duties of Forensic Scientist, Qualification of Forensic Scientist.

**UNIT - II**

**Forensic Biology:** Introduction, importance of various biological evidences (hair, fiber, pollens, wood), collection and evaluation in general, bite marks, human skeletal remains, importance and examination.

**Forensic Serology:** Forensic importance of various serological evidences (Blood serums, saliva, urine), collection, preservation and evaluation in general. DNA profiling: Introduction, importance and applications in forensic cases.

**UNIT- III**

**Forensic Entomology:** Forensic importance of various insects, importance of various insect growth stages, Entomological evidences, their location, collection and packing, Determination of time since death from entomological evidences.

**UNIT - IV**

**Forensic Microbiology and Molecular techniques:** Bacterial Pathogens, Bacterial Toxins, Virus general characteristics and diseases .DNA isolation, RFLP, MLST, Southern Blotting DNA finger printing.

## UNIT - V

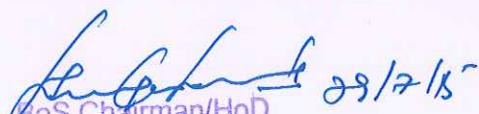
**Forensic Toxicology:** Introduction, types of cases, definition and classification of poisons, poisoning trends in India, collection and preservation of viscera, A brief introduction to extraction, isolation and identification of commonly used poisons (insecticides/pesticides, vegetable poisons, metallic poisons).

### TEXT BOOKS:

1. James, S.H and Nordby, J.J.. 2003. **Forensic Science : An introduction to scientific and investigative techniques** CRC Press,
2. Curry . 1986. **Analytical Methods in Human Toxicology**.,
3. Chowdhuri, S. 197): **Forensic Biology**, B P R & D, Govt. of India.
4. Jason H. Byrd and James L. Castner; 2001. **Forensic entomology**, CRC Press LLC,

### REFERENCE BOOKS:

1. Race, R. R. and Sangar, R. 1975: **Blood Groups in Man**. Blackwell Scientific, Oxford.
2. Prescott, L.M J.P. Harley and C.A. Klein 1995. **Microbiology** 2nd edition Wm, C. Brown Publishers.
3. Old. RW and Primrose, 1995 **Principle of Gene Manipulation**, 5th edition. Blackwell Scientific Publication, Boston.

  
BoS Chairman/HoD  
Department of Microbiology  
Dr. N. G. P. Arts and Science College  
Coimbatore - 641 048

  
Dr. P. R. MUTHUSWAMY  
PRINCIPAL  
Dr. NGP Arts and Science College  
Dr. NGP - Kalapatti Road  
Coimbatore - 641 048  
Tamilnadu, India