# SHRIMATI INDIRA GANDHI COLLEGE

(Nationally Accredited at "A" Grade (3rd Cycle) by NAAC)

Chatram Bus Stand, Tiruchirappalli – 620002.

# CRITERION - II

## 2.6.2. PO CO MAPPING FOR MICROBIOLOGY

## DEPARTMENT OF MICROBIOLOGY

## B.Sc., Microbiology

### Programme outcomes: (PO)

- Enhance knowledgeable in the subject of Science and apply the principles of the same to the needs of the Employer / nstitution / own business.
- Enhance the skills in handling scientific instruments, chemical, glassware, planning and performance in laboratory experiments
- Understand the basic concepts, scientific phenomena and their relevance in the day-to-day life
- Acquire the Analytical skills in the field/ area of Science.
- Acquire the knowledge with facts and figures related to various subjects in pure sciences

**Programme Specific outcomes: (PSO)**

- Acquire the fundamental knowledge of microorganisms and its types.
- Expore the metabolic characteristics and physiological activities of microbes.
- Elucidate the characteristics, specific nature and cultivation methods of virus.
- Clarify the relationships of microbes in relation with the immune system and medical field.
- Describe the various processes and products involved in the fermentation industries in connection with the microbial applications.

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## CORE COURSE I

## FUNDAMENTALS OF MICROBIOLOGY

**OBJECTIVE**

This subject aims to introduce the history and development of Microbiology. The contents of this course will help students understand history, biology of microorganisms, growth and control of microbes. Thus the beginners are rightly exposed to foundation of Microbiology which would lead them towards progressive advancement of the subject.

**Unit I**

Historical development of Microbiology- Theories of spontaneous generation – Biogenesis-The scope of Microbiology and the opportunities for microbiologistsbetween the prokaryotic and eukaryotic microorganisms. General principles and nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept- Carl Woese three domain classification. Eight kingdom classification.

**Unit II**

Microscopy: Principles and applications of bright field, dark field, phase contrast, fluorescent SEM and TEM. Specimen preparation of Electron Microscopy. Principles and types of staining– Simple, differential (Gram, Spore, AFB) Capsule staining (Negative), Sterilization: Principles and methods – physicalmoist heat, dry heat, filtration (Membrane and HEPA). Radiationschemical agents and mode of action.

**Unit III**

General characteristics and nature of Archaebacteria, Cyanobacteria, Mycoplasma, Rickettsiae, Chlamydia, Spirochaetes, Actinobacteria, Protozoa, Algae, Fungi and Viruses. Basic understanding of classification of viruses (ICTV), algae (ChapmanFritch), fungi (Alexopoulos) and protozoa.

**Unit IV**

Outline classification for bacteria as per the Bergey's Manual of Systematic Bacteriology (9th edition) -Structural organization of bacteria – Size, shape and arrangement of bacterial cells -Ultrastructure of a bacterial cell - cell wall, cell membrane, ribosomes, nucleoid, slime, capsule, flagella, fimbriae, spores , cysts, plasmid, mesosomes and cytoplasmic inclusions.

**Unit V** Cultivation of microbes- Types of culture media with specific examples for each type. Aerobic and Anaerobic culture techniques-Pure culture techniques (Tube dilution, Pour plate, Spread plate and Streak plate)-Methods of maintenance and preservation of microbes, safe decontamination practices.

**CO**

1. Identifydistributionofmicroorganisminnature
2. Determineevolutionofmicrobiologyandtheirrolein variousbiologicalprocesses
3. ClassifyMicroorganismsintodifferentcategoryaccordingto taxonomicranks
4. DetermineBiochemicalpropertiesofmicroorganisms

4. Calculate magnification,resolvingpower,depthoffocus,numericalaperture

**16SCCMB1-MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB1:1 | - | - | - | - | 3 | - | - | - | - |
| 16SCCMB1:2 | - | - | - | - | 3 | 1 | - | - | 1 |
| 16SCCMB1:3 | 2 | 2 | 1 | - | 3 | 3 | - | 1 | - |
| 16SCCMB1:4 | 3 | - | 2 | 3 | 3 | 3 | - | - | 1 |
| 16SCCMB1:5 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - |
| Average | 1.6 | 1 | 1.2 | 1.2 | 3 | 2 | - | 0.2 | 0.4 |

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**FIRST ALLIED COURSE I**

## BIOCHEMISTRY I

**OBJECTIVES**

To understand the structure, function and interrelationship of various biomolecules and consequences of deviation from normal.

**Unit I**

Carbohydrate– Definition, sources, classification, structure of glucose, biological significance, digestion and absorption.

**Unit II**

Proteins – Definition, sources, classification and structure of proteins (Primary, secondary, tertiary), Amino acids– structure- classification - essential and non- essential, protein and non-protein amino acids.

**Unit III**

Lipids - Definition, sources, classification, structure, properties and functions, Fatty acids-saturated, unsaturated and essential fatty acids

**Unit IV**

Nucleic acids – Definition, structure, forms and functions of DNA. Types, structure and functions of RNA (mRNA, tRNA, rRNA).

**Unit V**

Vitamins – Definition, sources, deficiency syndromes and functions of Fat soluble vitamins (A, D, E and K) and Water soluble vitamins (B complex and C).

**CO**

1.Describestructures,functions andclassificationofcarbohydrates,proteins,aminoacids,lipids, nucleicacids

2.Discuss metabolicandstructuralsignificanceofbio-molecules

3.Describefunctionalgroupsandbiochemicalinteractionspresentinbio-molecules

4.Explainconcepts ofpH,buffer,titrationcurveand pKa value

5.Explainconceptofenzyme,physicochemicalfactorscontributingtoenzymeactivity

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBC1:1 | 3 | 3 | 3 | 3 | - | 1 | 2 | - | - |
| 16SACBC1:2 | 3 | 3 | 3 | 3 | - | - | - | 2 | 1 |
| 16SACBC1:3 | 3 | 3 | 3 | 3 | - | - | - | 2 | 2 |
| 16SACBC1:4 | 3 | 3 | 3 | 3 | - | - | - | 2 | 1 |
| 16SACBC1:5 | 3 | 3 | 3 | 3 | - | - | - | 1 | 2 |
| Average | 3 | 3 | 3 | 3 | - | 0.2 | 0.4 | 1.4 | 1.2 |

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## CORE PRACTICAL I

## FUNDAMENTALS OF MICROBIOLOGY& MICROBIAL METABOLISM (P)

**Fundamentals of Microbiology**

1. Safety practices in Microbiological laboratory
2. Microscope and its operation
3. Principles and operations – Autoclave, Hot Air Oven, Filtration, Laminar Air Flow, Incubators, colony counter, Centrifuge, pH meter, Colorimeter and Spectrophotometer
4. Preparation of culture media, cleaning of glassware and sterilization methods
5. Demonstration of ubiquitous nature of microorganisms.
6. Measurement of size of microbes – micrometry.
7. Observation of permanent slides to study the structural characteristics of algae (*Anabena, Nostoc, Spirulina, Oscillotoria*), fungi (*Pythium, Rhizopus, Saccharomyces, Penicillium, Aspergillus, Agaricus*) and protozoa (*Entamoeba histolytica* and *Plasmodium* spp.).
8. Enumeration of bacterial numbers by Viable count ( Plate count) and Total count (Haemocytometer count)
9. Pure culture techniques - Streak plate, Pour plate and Spread plate.
10. Test for motility of bacteria – Hanging drop method.
11. Staining techniques – Simple staining, Gram's staining, Spore-staining, Capsular staining.
12. Isolation of bacteria, actinobacteria, fungi and cyanobacteria.

**Microbial Metabolism**

1. Bacterial growth curve: Cell count/viable count/absorbance (total count)
2. Carbohydrate fermentation tests: Glucose, Lactose, Sucrose and Mannitol.
3. Biochemical test for identification of bacteria: IMViC tests - TSI agar test- Urease- Catalase- Oxidase.

**CO**

1. Acquire knowledge on cleaning of glasswares, GLP and sterilization
2. Gain knowledge on media preparation and cultural characteristics
3. Learn the pure culture technique
4. Learn the microscopic techniques and staining methods
5. Learn the bacterial count using different methods
6. Study the macroscopical, microscopical and biochemical identification of bacteria

**16SCCMB1P**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB1P | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 |
| Average | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 |

**FIRST ALLIED PRACTICAL**

**BIOCHEMISTRY I AND II (P)**

1. Qualitative and Quantitative estimation of carbohydrates, amino acids, proteins, lipids and nucleic acids.
2. Estimation of ascorbic acid (from biological sample)

**CO**

1. Acquire knowledge of preparing molar, normal and percentage solutions
2. Estimating Carbohydrates, aminoacids, proteins lipids, ascorbic acid and nucleicacid**s.**

**16SACBC1P**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBC1P | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 |
| Average | 3 | 3 | 3 | 3 | - | - | - | 2 | 3 |

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## CORE COURSE III

## IMMUNOLOGY

**OBJECTIVES**

The aim of the course is to learn about the types of immunity, immune system, antigen, antigen anti-body reaction, hyper sensitivity reaction, immune deficiency disorders and concept of auto and transplantation of immunity.

**Unit I**

Introduction- History of immunology – Immunohematology- Blood groups, Blood transfusion, Rh-*Erythroblastosis faetalis*– immunity – types of immunity – innate and acquired immunity.

**Unit II**

Immune systems- Anatomy of lymphoid organ- Primary and Secondary Lymphoid organs – Cells of the immune system- detailed aspects of T and B cells receptors -subsets– Humoral and cell medicated immune response-activation and function, Complement, MHC.

**Unit III**

Antigen- Types, properties, haptans- adjuvants- vaccines- types – toxoids, antitoxins, Immunoglobulins-structure, types and properties. Theories of antibody production.

**Unit IV**

Antigen – antibody reaction- *in-vitro* methods- Agglutination – Precipitation, Complement fixation, Immunofluorescence, ELISA, RIA, *in-vivo* methods- Skin test, immunodeficiency disorder – AIDS.

**Unit V**

Hypersensitivity reactions – Immediate type - Type I Anaphylaxis, Type II Antibody dependent cell cytotoxicity, Type III Immune complex mediated, Type V Stimulatory; Delayed type- Type IV Cell mediated delayed hypersensitivity. Lymphokines and Cytokines. Basic concept in auto immunity and transplantation.

**CO**

1. Acquire the knowledge on the Immune system
2. Understand the Immunity and its types
3. Explain the Antigen and its types
4. Describe the Antigen-antibody reactions
5. Demonstrate the Hypersensitivity reactions and its types
6. Explain the Immunodeficiency disorders
7. Elaborate the Autoimmunity and transplantation

**16SCCMB3**

**MAPPING**

**CO - PO - PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB3:1 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 |
| 16SCCMB3:2 | 3 | 3 | 3 | 3 | - | - | - | 3 | 2 |
| 16SCCMB3:3 | 3 | 3 | 3 | 3 | - | - | - | 3 | 1 |
| 16SCCMB3:4 | 3 | 3 | 3 | 3 | - | - | - | 3 | 3 |
| 16SCCMB3:5 | 3 | 3 | 3 | 3 | - | - | - | 3 | 2 |
| Average | 3 | 3 | 3 | 3 | - | - | - | 3 | 2.2 |

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## SECOND ALLIED COURSE I

## BIOSTATISTICS

**OBJECTIVES**

1. To find numerical solutions to scientific data
2. To Analyse and interpret scientific data using numerical and mathematical equations

**UNIT I**

Introduction to biostatistics - Definition, statistical methods, biological measurement, kinds of biological data, functions of statistics and limitation of statistics.

**UNIT II**

Collection of data, sampling and sampling design, classification and tabulation, types of representations, graphic–bar diagrams, pie diagrams and curves.

**UNIT III**

Measures of central tendency, mean, median, mode, geometric mean, harmonic mean.

**UNIT IV**

Measures of dispersion and variability-changes. Deviations–Mean Deviation, Standard Deviation, Coefficient of variation, Loren Zen’s curve.

**UNIT V**

Skewness, Kurtosis, Moments, Meaning, test of skewness, characteristics of dispersion and skewness. Measures of skewness, objectives. Karl Pearson’s Coefficient of skewness, Bocoley’s coefficient of skewness.

**CO**

1. Elaborate the statistical methods and its functions
2. Describe the data collection and its graphical representation
3. Explain the various methods of data analysis
4. Understand the deviations of statistical data

**16SACBS1**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBS1:1 | 3 | 2 | 2 | 2 | - | - | - | - | 2 |
| 16SACBS1:2 | 2 | 3 | 3 | 3 | - | - | - | - | 1 |
| 16SACBS1:3 | 3 | 2 | 3 | 2 | - | - | - | - | 1 |
| 16SACBS1:4 | 3 | 3 | 2 | 2 | - | - | - | - | 2 |
| 16SACBS1:5 | 3 | 2 | 2 | 2 | - | - | - | - | 2 |
| Average | 2.8 | 2.4 | 2.4 | 2.2 | - | - | - | - | 1.6 |

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## CORE PRACTICAL II

## IMMUNOLOGY & INTRODUCTORY VIROLOGY (P)

**Immunology**

1. ABO Blood grouping
2. Rh typing
3. WIDAL Test
4. RPR
5. CRP
6. ASO
7. Total and differential blood cell count by haemocytometer
8. Double immunodiffusion
9. Demonstration of ELISA

**Virology**

1. Isolation of Bacteriophage from sewage
2. Concentration of bacteriophages
3. Demonstration of mechanical transfer of viruses in plants
4. Demonstration of cultivation of viruses by embryonated egg method.
5. Observation of selected bacterial, plant and animal viruses – T4 and M13 Phages, TMV, CaMV, HIV, Influenza, HSV, HBV, Rabies and Blue tongue virus

**CO**

1. Explore the blood groups and its types
2. Understand the various pathological conditions
3. Describe the blood cells and its types
4. Isolate the bacteriophage and its concentration method

Demonstrate the various viral diseases

**16SCCMB2P**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | P04 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB2P:1 | 3 | 3 | 3 | 3 | 1 | - | 3 | 3 | 3 |
| Average | 3 | 3 | 3 | 3 | 1 | - | 3 | 3 | 3 |

## SECOND ALLIED PRACTICAL
## BIOSTATISTICS AND BIOINFORMATICS (P)

1. Collection of data, sampling designs, tabulation and graphic representation using biological materials.
2. To find Mean, Mode, Median, Co-efficient of variance using biological materials.
3. Tests of significance ‘t’ test, ‘chi’ square, standard error and standard deviation.
4. ‘t’ Test, chi square, statistical error, standard deviation also, to be practically done through SPSS programme [statistical Package for Social Sciences].
5. Study of Nucleic acid sequence databanks – GenBank, EMBL nucleotide sequence databank, DDBJ.
6. Study of Protein Structure and Classification databases – PDB, SCOP and CATH.
7. Multiple alignment - ClustalW.
8. Evaluation of protein structure by Swiss PDB viewer and RASMOL.

**CO**

1. Apply the statistical tools to represent the biological data
2. Analyse the significance of the samples with statistical tests
3. Explore the biomolecules with various data banks
4. Evaluate the structure protein

**16SACBS1P - MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBS1P:1 | 3 | 2 | 2 | 3 | - | - | - | - | 2 |
| **Average** | **3** | **2** | **2** | **3** | **-** | **-** | **-** | **-** | **2** |

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## CORE COURSEV

## MEDICALMICROBIOLOGY

## OBJECTIVES

To impart the knowledge of medically important human diseases with respecttotheircausativeagent,clinicalsymptoms,pathogenesis,modeoftransmission,prevention andtreatment.

**UNITI**

History,Koch'sandRiver'spostulates-Abrief account on the normal microbial flora of the healthy human body-Host-pathogen interactions:Definitions of infection,invasion,primary and opportunistic pathogens,pathogenicity,virulence,toxigenicity,carriers,endemic,epidemic,pandemic diseases and epidemiology – putative virulence factors of human pathogens – infectious disease cycle.

**UNITII**

Diseasesofvariousorgansystems:Causativeagent,clinicalsymptoms,pathogenesis, mode of transmission, prevention and treatment of the followingbacterial diseases (a) Streptococcal infections, (b) Staphylococcal infections, (c)Meningitis,(d)Leprosy,(e)Leptospirosis,(f)Respiratorydiseases:Tuberculosis (g) Gastrointestinal disorders: typhoid, cholera, bacillary dysentery, (h) Sexuallytransmitteddiseases:syphilis,gonorrhea.(i)Anaerobic wound infection – tetanus,gasgangrene.

**UNITIII**

Diseases of various organ systems:Causative agent,clinical symptoms,pathogenesis, mode of transmission, prevention and treatment of the following viral diseases (a)Respiratory diseases:commoncold,influenza,measles .(b)Neurological diseases:Dengue,Rabies(c)Liverdiseases:Viral hepatitides (d)Immunodeficiency disease:-AIDS.A brief accounton Prion diseases.

**UNITIV**

Causative agent,clinical symptoms,pathogenesis,mode of transmission,prevention and treatment of the following fungal and protozoan diseases (a)Fungal–superficial and subcutaneous mycoses,(b)Protozoan: Amoebiasis,Malaria (c) Helminths – Filariasis, Ascariasis, Zoonotic diseases, A brief account on nosocomial and community acquired infections.

**UNITV**

Steps in the isolation and identificationof pathogens from an infected patient:Collection and transport of various clinical specimens for diagnosis–General methods ofi solation and i dentification of bacterial,fungal and viral pathogens and protozoan parasites.

Course Outcomes: (CO)

- Clarify the epidemiology of bacterial, fungal and protozoan infections
- Describe the life cycle, pathogenesis, and diagnosis of viral infections
- xplain the methods of cultivation of pathogenic bacteria
- Identify the modes of bacterial, fungal and protozoan infections
- Elaborate the normal flora of humans
- Determine the antibiotic resistance in bacteria

**16SCCMB5-MEDICAL MICROBIOLOGY**

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB5 : 1** | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 2 | 3 |
| **16SCCMB5: 2** | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |
| **16SCCMB5: 3** | 2 | 3 | 3 | 1 | 2 | 1 | 3 | 2 | 3 |
| **16SCCMB5: 4** | 3 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 2 |
| **16SCCMB5: 5** | 2 | 3 | 1 | 3 | 2 | 1 | 2 | 3 | 2 |
| Average | 2.6 | 2.6 | 2 | 2.2 | 2.4 | 1.4 | 2.6 | 2.6 | 2.4 |

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## CORECOURSEVI

## AGRICULTURALANDENVIRONMENTALMICROBIOLOGY

**OBJECTIVES:**

To provide the fundamental knowledge about the various scopes on Agricultural and Environmental microbiology and their concepts, Plantdiseases,Aeromicrobiology,Aquaticmicrobiology,disposalofwastesandcommercialaspects of soil microbiology.

**UNITI**

Microorganisms in the rhizosphere,root surfaces and phylloplane-Biofertilizer –Advantages over chemical fertilizers, types, production and - quality control of biofertilizers-Isolation,mass inoculum production,field application,importance and marketing of bioinoculants–
Rhizobium,Azotobacter,Azospirillum,Frankia,Cyanobacteria,Azolla and phosphate solubilizing microorganisms-Mycorrhizal biofertilizers.

**UNITII**

Plantdiseases (Mode of entry of pathogens, Symptoms, Disease cycle andcontrolmeasures)Bacterialdisease–Citruscanker-Fungaldisease–Rustofwheat-Mycoplasmaldisease–Grassyshootofsugarcane-Viraldisease–cauliflowermosaic-Microbial Pesticides – types and applications –*Pseudomonas fluorescens, Bacillus thuringiensis, Trichoderma viride* andNuclearPolyhedrosisVirus(NPV).

**UNITIII**

Concepts of microbial ecology: Relationship between microorganism and different environments land, water and air. Microorganisms inhabiting extremeenvironments.Microbiology of air–distribution and sources.Dropletnuclei,aerosol,assessment of air quality.Brief account of airborne transmission of harmfulmicrobes.

**UNITIV**

Types of aquatic ecosystems:freshwater – ponds, lakes, streams. Marine habitats–estuaries,mangroves,deep sea. Zonations – upwelling –eutrophication – food chain. Potability of water – microbial assessment of water quality–water purification–brief account of waterborne diseases.

**UNITV**

Types of wastes–characterizationofsolidandliquidwastes.Solidwastetreatment–saccharification–gasification–composting, Utilization of solidwastes for mushroom production.Liquid wastetreatment-Treatment methods–primary and secondary (anaerobic–methanogenesis) aerobic: trickling,activatedsludge,oxidationpond–tertiary treatment.

Course Outcomes: (CO)

- Understand the microorganisms in the Rhizosphere and phylloplane zones
- Explain the various plant diseases
- Demonstrate the aeromicrobiology
- Elaborate the methods of waste disposal
- Describe the commercial aspects of soil microbiology

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB6 : 1** | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 |
| **16SCCMB6: 2** | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **16SCCMB6: 3** | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 |
| **16SCCMB6: 4** | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 |
| **16SCCMB6: 5** | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **Average** | 2.6 | 2.2 | 2 | 2 | 2.6 | 2 | 2.2 | 2.2 | 2.2 |


## CORECOURSEVII

## MOLECULARBIOLOGYANDMICROBIALGENETICS

### OBJECTIVE

To provide thestudentswiththefundamentalprinciplesandconceptsofprokaryotic genes and genomes, their molecular organization, replication andfunctioning.

### UnitI

Milestonesinhistory–Definition of nucleicacids-Experimental proofs of DNA asthegenetic material(GriffithandHersheyChase) – Experimental proofs ofRNAasthe genetic material - Chemistry and molecular structure of DNAdouble helix - Discovery of DNA structure – Brief account on types and forms ofDNA–TypesofRNA-Definition of a gene.Organization of DNA in prokaryotes(*E.coli*)and viruses.Brief note on plasmids:structure and types.

### UnitII

DNA Replication in prokaryotes:Meselson and Stahl experiment–Mechanism,enzymes and proteins of replication–Theta replication and Rolling circle replication.Replication of RNA–reversetranscriptase.

### UnitIII

DNA Transcription: Definition – Brief account on transcriptional machineryand mechanism of transcription – Genetic code – RNA Translation: Definition -– Briefaccountontranslationalmachineryandmechanismsoftranslation.Regulationofgeneex pressioninprokaryotes–Operonconcept–*lac*and*trp*operons.

### UnitIV

Transformation - Discovery, mechanism of natural competence - Conjugation - Discovery,$F^+$*v/s* $F^-$, $Hfr^+$*v/s* $F^-$- Transduction – Generalized and specializedtransductions.

### UnitV

Definitions of mutations,mutagenesis and mutants-types of mutations;Physical and chemical mutagens.Transposons-Applications of mutations,Carcinogenicity

testing.DNA repair mechanisms.

**Course Outcomes: (CO)**

- Understand the basics of genetics
- Explain the structure and chemical nature of DNA and RNA
- Elaborate the replication methods of DNA and RNA
- Describe the process of transcription and translation
- Clarify the various methods of bacterial reproduction
- Comprehend the mutation and its types

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB7 : 1** | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 3 | 2 |
| **16SCCMB7: 2** | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 |
| **16SCCMB7: 3** | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 1 |
| **16SCCMB7: 4** | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 |
| **16SCCMB7: 5** | 3 | 2 | 2 | 1 | 3 | 2 | 1 | 2 | 3 |
| **Average** | 2.6 | 2.2 | 2 | 2 | 2.6 | 2 | 2.2 | 2.2 | 2.2 |

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## COREPRACTICALIII

## MEDICALMICROBIOLOGY,AGRICULTURAL AND ENVIRONMENTALMICROBIOLOGY &MOLECULARBIOLOGYANDMICROBIALGENETICS(P)

### MedicalMicrobiology

- Isolation of bacterial flora o fskinbyswabmethod.
- Isolation of bacteria from urine,stool and sputum
- Identification of Grampositive organisms(using laboratory strains):*Streptococcuspneumoniae*,*Staphylococcusaureus* and *Bacillus* sp. *and*Gramnegativeorganisms(usinglaboratorystrains):*Escherichiacoli*,*Proteus*sp. and *Klebsiella pneumoniae* on the basis of microbiological, cultural and biochemical characteristics.
- Saline and iodine wet mount to demonstrate protozoan parasites
- Giemsastaining for the demonstration of bloodparasites
- KOH and Lactophenol cotton blue mount to demonstrate fungi.
- Germ tube technique to identify*Candida albicans.*
- Anti bacterial sensitivity test–Kirby-Bauermethod.
- Observation of symptoms of diseases caused by bacterial,fungal,viral and protozoan pathogens using photographs.

### AgriculturalandEnvironmentalmicrobiology

- WateranalysisbyMPNtechnique–presumptivecoliformtest–confirmedcoliformtestandcompletedcoliformtest.
- Microbial assessments of airquality – open platemethod and air sampler-technique.
- Isolationandcountingoffaecalbacteriafromwater.
- SoilAnalysis-pH,chlorides,nitrate,calcium,magnesiumandtotalphosphorus.
- Isolation o fcyanobacteriafromwater(anytwo)
- Isolation of *Rhizobium*formlegumenodule.
- Isolation of phosphobacteriafromsoil.
- Observation of VAM fromplantroots.

### MicrobialgeneticsandMolecularbiology

- Isolation of chromosomalDNAfrombacteria
- Isolation of plasmidDNAfrombacteria
- Isolation of Auxotrophic mutants.
- Demonstration of bacterial transformation technique.
- DemonstrationofAgarosegelelectrophoresis(tostudyDNA/RNA)andSDS –PAGE(tostudyproteins).

**Course Outcomes: (CO)**

- Demonstrate the isolation methods of bacteria from the body fluid
- Identify the types of bacteria by microbiological, cultural and biochemical characteristics
- Determine the quality of air and water
- Analyse the physical, chemical nature of the soil
- Isolate the types of bacteria from various sources

**16SCCMB3P – MEDICAL MICROBIOLOGY, AGRICULTURALANDENVIRONMENTALMICROBIOLOGY &MOLECULARBIOLOGYANDMICROBIALGENETICS(P) MAPPING**

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSOC O | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB3P : 1** | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 2 |
| **Average** | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 1 | 2 |

**MAJOR BASED ELECTIVE I FUNDAMENTALS OF BOTANY AND ZOOLOGY**

## Objectives

1. To gain the basic knowledge about plants and animals.
2. To studythebio-controlmeasuresofplants.

**UNITI**

Introduction,Plantnomenclature-Binomialsystem,International code of Botanical Nomenclature(ICBN).Classification-Artificial and Natural system.Planttaxonomy.

**UNITII**

Salient features, distribution and economic importance of angiosperms, gymnosperms,pteridophytes,bryophytes and Lichens.

**UNITIII**

Physiology and reproduction of plants - photosynthesis, sexual and asexual reproduction.

**UNITIV**

Introduction to animal kingdom - Evolution theory. –Brief introduction of invertebrates and vertebrates.

**UNITV**

Cell reproduction–Mitosis and Meiosis-Origin of germcells-process of spermatogenesis and oogenesis.Types of eggs.

**Course Outcomes: (CO)**

- Explain the classification of plants
- Describe the features and economic importance of plant kingdom
- Demonstrate the physiology and reproduction of plants
- Clarify the evolutionary theory of animals
- Comprehend the cell reproduction

**16SCCMBEMB1 –FUNDAMENTALSOFBOTANYANDZOOLOGYMAPPING**

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSOC O | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMBEMB 1 : 1** | 3 | 1 | 2 | 3 | 2 | 1 | - | 1 | 3 |
| **16SCCMBEMB 1 : 2** | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 1 |
| **16SCCMBEMB 1 : 3** | 3 | 2 | 1 | 2 | 2 | - | 1 | 3 | 2 |
| **16SCCMBEMB 1 : 4** | - | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 3 |
| **16SCCMBEMB 1 : 5** | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 2 | 2 |
| **Average** | 2.2 | 1.8 | 1.8 | 2 | 2 | 1.4 | 1.6 | 1.8 | 2.2 |

## DEPARTMENTOFMICROBIOLOGY

## B.Sc., Microbiology

### Programme outcomes: (PO)

- Enhance knowledgeable in the subject of Science and apply the principles of the same to the needs of the Employer / nstitution / own business.
- Enhance the skills in handling scientific instruments, chemical, glassware, planning and performance in laboratory experiments
- Understand the basic concepts, scientific phenomena and their relevance in the day-to-day life
- Acquire the Analytical skills in the field/ area of Science.
- Acquire the knowledge with facts and figures related to various subjects in pure sciences

**Programme Specific outcomes: (PSO)**

- Acquire the fundamental knowledge of microorganisms and its types.
- Explore the metabolic characteristics and physiological activities of microbes.
- Elucidate the characteristics, specific nature and cultivation methods of virus.
- Clarify the relationships of microbes in relation with the immune system and medical field.
- Describe the various processes and products involved in the fermentation industries in connection with the microbial applications.

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## CORE COURSE II MICROBIAL METABOLISM

**OBJECTIVE**

To understand the growth, enzymology and physiological processes of microbes

**Unit I**

Nutrition and growth of microorganisms: Nutritional types of microorganisms, nutritional requirements. Factors influencing the growth of microorganisms – temperature, pH, Osmotic pressure, moisture, radiations and different chemicals, Physiology of growth – Significance of various phases of growth. Growth measurements – batch, continuous and synchronous.

**Unit II**

Bacterial enzymes – classification, properties, kinetics of enzyme action – Michaelis Menton equation for simple enzymes - coenzymes and cofactors, isozymes.

**Unit III**

Metabolism of carbohydrates : Anabolism – phototsynthesis – oxygenic – an oxygenic, synthesis of carbohydrate – catabolism of glucose – Embden Mayer – Hoff – Parnas pathway – Pentose pathway, Kreb's cycle (TCA) – electron transport system and ATP production.

**Unit IV**

Metabolism of protein – synthesis and degradation of amino acids – glycine tyrosine, cysteine, serine, glutamine, synthesis of peptides and proteins – urea cycle.

**Unit V**

Anaerobic Respiration – Nitrate, sulphate and Methane respiration – Fermentations – alcohol, mixed acid, lactic acid fermentation – Metabolism of lipids – biosynthesis of fatty acids and cholesterol – oxidation of fatty acids.

**CO**

1. Explain the nutrition and growth of microorganisms
2. Describe the bacterial enzymes – classification, properties and kinetics of enzyme action
3. Elaborate the metabolism of carbohydrates, proteins and lipids
4. Demonstrate the anaerobic mode of respiration

**16SCCMB2**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB2:1 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - |
| 16SCCMB2:2 | 3 | 3 | 3 | 2 | 2 | - | 1 | 3 | 2 |
| 16SCCMB2:3 | 3 | 3 | 3 | 3 | 2 | - | 1 | 1 | 2 |
| 16SCCMB2:4 | 3 | 3 | 3 | 1 | 2 | - | 1 | 3 | 2 |
| 16SCCMB2:5 | 3 | 3 | 3 | 3 | - | - | - | - | - |
| Average | 3 | 3 | 3 | 2.4 | 1.8 | 0.6 | 0.6 | 1.4 | 1.2 |

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## FIRST ALLIED COURSE III BIOCHEMISTRY II

**OBJECTIVE**

To understand the structure and functions of blood, hormones and phtohormones.

**UNIT I**

Blood–Introduction, origin, composition, characterization, functions and coagulation of blood.

**UNIT II**

Hormones–Definition, classification of hormones, Human- Endocrine glands – Pituitary, thyroids, Para thyroid, pancreas, adrenal, testis and ovary.

**UNIT III**

Diseases associated with deficiency of endocrine hormones- hypo and hyper secretions.

**UNIT IV**

General account and secondary metabolites. Major and accessory plant pigments – chlorophylls, carotenoids, phycobilins and anthocyanins.

**UNIT V**

Phytohormones –structure and functions of auxin, gibberellins, cytokinins and abscissic acid.

**CO**

1. Understand the blood groups and its functions
2. Explain the types of hormones and the endocrine glands
3. Demonstrate the diseases related with the hormones
4. Acquire the knowledge on secondary metabolites
5. Elaborate the phytohormones structures and the functions

**16SACBC2**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBC2:1 | 3 | 2 | 3 | 3 | - | - | - | 2 | 2 |
| 16SACBC2:2 | 3 | 2 | 3 | 3 | - | - | - | 1 | 2 |
| 16SACBC2:3 | 3 | 2 | 3 | 3 | - | - | - | 1 | 2 |
| 16SACBC2:4 | 3 | 1 | 2 | 2 | - | - | - | 2 | 1 |
| 16SACBC2:5 | 3 | 2 | 1 | 2 | - | - | - | 1 | 2 |
| Average | 3 | 1.8 | 2.4 | 2.6 | - | - | - | 1.4 | 1.8 |

## CORE COURSE IV

## INTRODUCTORY VIROLOGY

**OBJECTIVES**

To make the student and learn about the structure, classification, morphology, pathological importance of viruses and viral diseases.

**Unit** I

History of virology, terminologies, origin of viruses, occurrence, morphology of viruses, helical, icosahedral and complex viruses. Viral envelope, nucleic acids, proteins, carbohydrates, classification of viruses- LHT and ICTV system of classification.

**Unit II**

Purification, Characterization, Separation and Assay. Cultivation and quantification of viruses, Separation and characterization of viral components.

**Unit III**

Bacteriophages- Life Cycle, Classification, Morphological groups, the virulent dsDNA phage, the ssDNA phage, phage lambda, Temperate and Transposable phage, Phage Mu the ssDNA phages, phage M13, Bacteriophage typing, Phage therapy (bacteriophage therapy), Cyanophages, Mycoviruses (Mycophages), Rhizobiophages.

**Unit IV**

General characteristics and multiplication of DNA containing viruses- Adenoviruses, Herpes viruses, Poxviruses. RNA containing viruses- Picorna virus, Rhabdo viruses, Orthomyxo viruses, Reoviridae, SARS and H1N1- Influenza A virus. Subviral agents - Viroids, Prions.

**Unit V**

History, Classification and nomenclature of plant viruses, Transmission, Multiplication, symptoms and control of plant viral diseases - DNA containing virus - Cauliflower mosaic virus, RNA containing virus - Tobacco mosaic virus- Poty virus, Tomato spotted wilt, Potato leaf roll virus, Rice tungro virus, Mosaic disease of sugarcane. Sub viral agents –Virusoids and Satellite virus.

**CO**

1. Understand the virus and its classification
2. Describe the phages and its types
3. Elaborate viral diseases of plants, animals and microorganisms
4. Clarify the epidemiology of viruses

**16SCCMB4**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SCCMB4:1 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 2 | 2 |
| 16SCCMB4:2 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 2 | 1 |
| 16SCCMB4:3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 |
| 16SCCMB4:4 | 3 | 2 | 3 | 3 | 1 | 1 | 3 | 1 | 2 |
| 16SCCMB4:5 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 2 |
| Average | 3 | 2.2 | 2.8 | 3 | 1.2 | 1.6 | 3 | 1.7 | 1.8 |

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## SECOND ALLIED COURSE III

## BIOINFORMATICS AND COMPUTER APPLICATIONS IN BIOLOGY

**OBJECTIVES**

1. To obtain basic knowledge about computers and internet.
2. To develop the computational methods to utilize expression data's of cellular biology.
3. To study of the inherent structure of biological information.
4. To analyze the gene and protein sequences to reveal protein evolution.

**UNIT I**

Computers – Characteristics of Computers – Areas of computer applications- I- P-O Cycle. Components of Computers – Memory and control units-Input devices and output devices- Hardware and Software -Operating Systems.

**UNIT II**

Internet –History of Internet-Uses of internet. Connection to Internet - Getting connection-Web page-Modem-Internet Service providers-E-mail and Voice Mail, Creating E-mail Address.

**UNIT III**

Introduction to bioinformatics – history and its development – Scope and applications of bioinformatics.

**UNIT IV**

Biological database – NCBI-GenBank, EMBL, DDBJ. Sequence Alignment- Pairwise (BLAST and FASTA) and Multiple sequence alignment (ClustalW).

**UNIT V**

Structure of Protein, Classification –PDB, Swiss-PROT, SCOP, CATH. Protein visualization tools-RASMOL, Swiss PDB viewer.

1. Understand the basics and applications of computers
2. Describe the internet, internet services
3. Explain the scope, development and applications of Bioinformatics
4. Demonstrate the biological databases
5. Analyse the list of protein data bases

**16SACBS2**

**MAPPING**

**CO - PO – PSO matrices of course**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

| PO/PSO/CO | PO1 | PO2 | PO3 | PO4 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|
| 16SACBS2:1 | 3 | 3 | 3 | 3 | - | - | - | - | - |
| 16SACBS2:2 | 3 | 3 | 3 | 3 | - | - | - | - | 1 |
| 16SACBS2:3 | 3 | 2 | 3 | 3 | - | - | - | 2 | 2 |
| 16SACBS2:4 | 3 | 2 | 3 | 3 | - | - | - | 3 | 2 |
| 16SACBS2:5 | 3 | 3 | 3 | 3 | - | - | - | 3 | 2 |
| Average | 3 | 2.6 | 3 | 3 | - | - | - | 1.6 | 1.4 |

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# FOODMICROBIOLOGY

## UnitI

Concept s of food andnutrients-Physicochemicalproperties off oods–Food and microorganisms–Importance and type s of microorganisms in food(Bacteria, Mould and Yeasts) - Sources of contamination- Factors influencing microbial growth in food–pH,moisture,Oxidation-reduction potential,nutrient contents and inhibitory substances.

## UnitII

FoodFermentations–Manufacture of fermented foods-Fermented dairy products(yoghurtandCheese)-plantproducts- Bread, Sauerkraut andPickles-Fermentedbeverages-Beer.Brief account onth esources andapplications of microbial enzymes – Terminologies - Prebiotics Probiotics and synbiotics. Advantages of probiotics.

## UnitIII

Contamination,spoilage and preservation of cereals and cerealproducts -sugar and sugar products-Vegetablesandfruits-meat and meat products-Spoilage of canned food.

## UnitIV

Food borne diseases and food poisoning – *Staphylococcus*, *Clostridium*, *Vibrioparahaemolyticus*and*Campylobacterjejuni*.*Escherichiacoli*and*Salmonella*infections,Hepatitis,Amoebiosis.AlgaltoxinsandMycotoxins.

## UnitV

Foodpreservations:principles-methodsofpreservations-Physicalandchemical methods- food sanitations- Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies.FDA,EPA,HACCP,ISI.HACCP–Food safety-control of hazards

**CO**

- Illustrate the role of microorganisms in food safety
- Compare various physical and chemical methods to control the microorganisms in food
- Explain the factors that affect microbial growth in food
- Discuss microbial spoilage of food
- List food borne diseases
- Differentiate food borne infection and intoxication

**16SCCMB8– FOOD MICROBIOLOGY MAPPING**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSOC O | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB8: 1** | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| **16SCCMB8 : 2** | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| **16SCCMB8: 3** | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 3 |
| **16SCCMB8: 4** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| **16SCCMB8 : 5** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **Average** | 3 | 2.4 | 2 | 2.2 | 2.8 | 2.8 | 2.2 | 1.6 | 3 |


## CORE COURSE IX-INDUSTRIALMICROBIOLOGY

**UNITI**

Historical development of Industrial Microbiology ,Industrially important microorganisms,sources and characters;Primaryand secondary screening and preservation of industrially important strains, Major classes of products and processes.Strain improvement.

**UNITII**

Fermenter - Design, types and basic functions. Characteristics of production media,Fermentation media-formulation strategies, economical means of providing energy, carbon,nitrogen,vitamin and mineral sources,role ofbuffers,precursors,inhibitors,inducers and antifoams.Sterilization of fermentationequipment,air and media.Types of fermentation.

**UNITIII**

Downstream processing - recovery and purification of fermentations products(intracellularandextracellular),celldisruption,precipitation,filtration,centrifugation,solventrecovery,chromatography,Ultrafiltration and drying,Quality assurance(QC)of finished product.Immobilization of cell and enzymes.

**UNITIV**

Microbial products of pharmaceutical value–rawmaterials,organism andindustrialprocessesinvolvedintheproductionofPenicillin,Streptomycin,VitaminB12,Riboflavin and rabies vaccine.

**UNITV**

Microbial products of industrial value – raw materials, organism and industrial processes involved in the production of ethanol,vinegar,amylase,protease,glutamicacid.Recycling and disposal of industrial wastes through microbes

**CO**

- Elaborate various aspects of industrial technology related to microbiology
- Screen industrially important strains
- State and explain the principles of fermenter design and computer assisted control
- Discuss fermentation process and downstream processing
- Describe industrial production of enzymes, antibiotics and amino acids

**16SCCMB9– INDUSTRIAL MICROBIOLOGY MAPPING**

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB9: 1** | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 1 | 2 |
| **16SCCMB9: 2** | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 |
| **16SCCMB9: 3** | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 3 |
| **16SCCMB9: 4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 2 |
| **16SCCBC9: 5** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **Average** | 3 | 2.2 | 1.6 | 2.2 | 2.6 | 2.4 | 2.4 | 1.6 | 2.6 |


**COREPRACTICALIV**

**FOODANDINDUSTRIALMICROBIOLOGY(P)**

1. Assessment of milk quality by methylene blue reduction test
2. Performance of phosphatase test for pasteurizedmilk.
3. Isolation of bacteria from food by Standard Plate Count
4. Isolation of Yeast from grapes.
5. Wetmount preparation of spoiled bread,tomato,grapes,potato.
6. Observation of food samples to study *Leuconsostoc*, *Lactobacillus,Streptococcus lactis* and *Saccharomyes*.
7. Immobilization of yeastcell using s odiumalginate
8. Alcohol fermentation by *Saccharomyces cerevisiae*.
9. EstimationofalcoholusingPotassiumDi-chromatemethod.
10. Production of Citricacidu sing*A spergillusniger*
11. Starch(Amylase),casein(Protease)andlipid(Lipase)hydrolysestests

**Demonstration**

1. Preparation of fermented food–Yoghurtandcheese
2. Screening of bacteria and actinobacteria for antibioticproduction
3. Screening of bacteria and actinobacteria forenzyme production

**CO**

- Cultivate and enumerate microorganisms from various food samples
- Understand the beneficial role of microorganisms in fermented foods
- Know the spoilage mechanisms in foods
- Identify the methods to control the deterioration and spoilage of food
- Learn the various methods for involved in the production of industrially important products

**16SCCMB4P– FOOD AND DAIRY MICROBIOLOGY (P) MAPPING**

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

| PO/PSOC O | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SCCMB4P : 1** | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| **Average** | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |

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## MAJOR BASED ELECTIVEII-RECOMBINANTDNATECHNOLOGY

### OBJECTIVES

To educate the learners with the fundamental knowledge and importance of recombinant DNA(rDNA)technology.To teacht he jargons of geneticengineering/rDNAtechnology as well as the basic tools, techniques and methods employed in gene cloning and gene expression strategies.

### UNITI

Milestones in rDNA technology - Definition of gene manipulation - Major steps involved in genecloning-Isolation and Purification of Chromosomal and Plasmid DNA, Isolation and Purification of RNA - Chemical Synthesis of DNA,GenomicLibrary and cDNALibrary-applications.

### UNITII

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

### UNITIII

Cloning vectors: Definition and properties – Plasmid based vectors: Naturalvectors (pSC101, pSF2124, pMB1), Artificial vectors (pBR322 and pUC) - Phagebased vectors- ג (Lamda) phage vectors and its derivatives - Hybrid Vectors-PhagemidandCosmid,BACandYAC–Expressionsystems–*E.coli*.

### UNITIV

Gene/DNAtransfertechniques:Physical–BiolisticMethod(Genegun),Chemical-Calcium chloride and DEAE Methods, Biological *in vitro* packagingmethod in viruses - Selection and Screening of recombinants: Direct Method:Selection by Complementation,Marker inactivation methods-Indirect methods:Immunological and Genetic methods.

### UNITV

Blotting (Southern, Western, Northern and North- eastern) techniques – PCR -

basic steps in DNA amplification, RAPD, RFLP and their applications – DNAfinger printing - DNA microarray analysis – Applications of recombinant DNAtechnology.

**CO**

- Illustrate the tools and techniques in r DNA technology
- Discuss the handling and applications of different DNA and RNA modifying enzymes
- Explain the construction of genomic and DNA library
- Identify the problems associated with the production of recombinant proteins
- Demonstrate various applications of r DNA technology
- Clarify the environmental applications of Genetic Engineering through bioremediation

**16SMBEMB2– RECOMBINANTDNATECHNOLOGY** MAPPING

**CO - PO – PSO matrices of course**

1:Slight(Low)2:Moderate(Medium)3:Substantial(Hi

gh)If there is no correlation, put "-"

| PO/PSOC O | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SMBEMB2 : 1** | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| **16SMBEMB2: 2** | 3 | 2 | 1 | 2 | 3 | 2 | 2 | 2 | 2 |
| **16SMBEMB2: 3** | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 3 |
| **16SMBEMB2: 4** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 |
| **16SMBEMB2: 5** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **Average** | 3 | 2.8 | 1.8 | 2.2 | 2.8 | 2.8 | 2.2 | 1.6 | 2.6 |

**MICROBIAL BIOTECHNOLOGY AND BIOETHICS**



## OBJECTIVES

To provide the first-line knowledge of utilizing microbes for the industrial production of an array of economically viable products possessing a variety of human applications.

### UNITI

Biotechnology:Definition–Milestonesin History - Scope of microbial biotechnologyand its applications - Microbial production of pharmaceuticals – antibiotics, hormones(insulin), enzymes (streptokinase), recombinant vaccines (Hepatitis B vaccine) - Ediblevaccine,Monoclonalantibodies.

### UNITII

Microbial production of biofertilizers– (*Rhizobia,Azospirillum,Frankia*andVAM).Microbial production of bio-pesticides (*Bacillus thuriengiensis*). Microbial production of bioplastics.Microorganisms in bioremediation:Degradationofxenobiotics.

### UNITIII

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

### UNITIV

Genetic engineering of plants :Tiplasmid vectors and gene transfer in plants–Development of insect,virus and herbicide resistant plants. Transgenic animals: methods of creatin gtransgeni cmiceandsheep. Humangene therapy – *in vivo* and *exvivo*genetherapy.

### UNITV

Intellectual Property Rights (IPR) - different types of IPRs - Principles of Bioethics (IB) -DefinitionofEthicsandBioethics. - Ethics committee - Brief account on risks andethicsofmodernbiotechnology- Ethicalconcerns in human gene therapy - Ethica llimits of animal use.Ethical issues at the beginning of life (abortion)–Ethical issues at the end of life(withholding and withdrawing medical treatmen tande uthanasia).

**CO**

- Outline the various products of microbial origin
- Explain the microbial biofertilizers
- Describe the single cell protein and its biotechnological potentials
- Elaborate the genetic Engineering of plants
- Understand the ethical aspects of human welfare

**16SMBEMB3-MICROBIAL BIOTECHNOLOGY AND BIOETHICS MAPPING**

**CO - PO – PSO matrices of course**

| PO/PSO<br>CO | PO1 | PO2 | PO3 | PO4 | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 |
|---|---|---|---|---|---|---|---|---|---|
| **16SMBEMB3: 1** | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 1 | 3 |
| **16SMBEMB3: 2** | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **16SMBEMB3: 3** | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 2 |
| **16SMBEMB3: 4** | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 |
| **16SMBEMB3: 5** | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| **Average** | 3 | 2.4 | 2 | 2.2 | 2.6 | 2.8 | 2.2 | 1.6 | 2.6 |

1:Slight(Low)2:Moderate(Medium)3:Substantial(High)If there is no correlation, put "-"

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## M.Sc., Microbiology

**Programme Outcomes:**

Develop professional foundations through activities such as teaching, internship and fellowships.
* Attained profound Expertise in Discipline
* Acquire the basic tools needed to carry out independent research.
* Proficient in their specialized area and successfully complete an advanced research project.
* Develop skills in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
* Acquired ability to function in Multidisciplinary Domains

**Programme Specific Outcomes:**

1. Understand the nature and basic concepts of Microbiology
2. Analyse the relationships of microorganisms with other organisms
3. Explain the applications of microbiology in Agriculture, medicine and Environment
4. Expertise both theoretical and practical aspects of the microbiology discipline
5. To contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level

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## CORE COURSE I -FUNDAMENTALS OF BIOLOGICAL SCIENCES

### OBJECTIVE

To enable the students to understand the basic knowledge in Biological Sciences

### Unit I Algae and Fungi

Thallophytes: Algae-General characteristics- Economic importance- Types of life cycle-Outline of various classifications. Fungi: General characteristics- Classifications and Economic importance

### Unit II Plant reproduction

General characteristics- Economic importance and outline of reproduction methods in Bryophytes, Pteridophytes and Gymnosperms.

### Unit III Plants

Basics of plant cell – Monocot and dicot - Classification of plant diversity – Classes of plant kingdom- Morphology: Inflorescence types -Racemose, cymose, and Mixed –Special types, Cyathium, Hypanthodium, Verticillaster and Thyrsus. Technical description of flower and floral diagram- Microsporangium and structure of Polygonum type embryo sac- Taxonomy: Systems of classification, (Artificial, Phylogenetic and Natural). Outline of Bentham and Hooker's classification.

### Unit IV Invertebrates

General characteristics and outline classification upto classes in Protozoa, Porifera,Coelenterata, Platyhelminthes and Ashelminthes; Economoic importance of invertebrates.Classification of Chordata – Characteristic features - protochordata class – Pisces and Amphibia up to orders - General characters - a brief study on Star fish.

### Unit V Vertebrates and pests control

Salient features of Reptilia, Aves and Mammalia- Economic importance of Vertebrates.Bioluminescence. Insect pests of rice, sugarcane, coconut, cotton, vegetables, fruits and stored products (with an example of each). Principles of insect control: physical,mechanical, chemical, biological and integrated methods of pest control.

**COS**

- Understand the basic concepts of Biology
- Explain the general characters and reproduction of algae and fungi
- Describe the characters, types and reproduction in plants
- Elaborate the characters and methods of reproduction in animals
- Clarify the methods of pest control

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **P16MB11.1** | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| **P16MB11.2** | 3 | 3 | 2 | - | 3 | 2 | 2 | 3 | 3 | 3 |
| **P16MB11.3** | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| **P16MB11.4** | 2 | 3 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 |
| **P16MB11.5** | 3 | - | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **Average** | 2.4 | 2.2 | 2.6 | 2.2 | 2.8 | 2.6 | 2 | 2.6 | 2.8 | 3 |

1"–Slight (Low) Correlation,"2" – Moderate (Medium) Correlation,"3"–
Substantial (High) Correlation,"-"indicatesthereisnocorrelation

## CORE COURSE II- GENERAL MICROBIOLOGY

## OBJECTIVE

To enable the students to understand the basic knowledge in Microbiology

**Unit I Ultra structure and function-**Bacteria: Morphological types; cell wall – cell walls of Gram negative, Gram positive,halophiles. L-forms and Archaebacteria, Cell wall synthesis, cell membrane, capsule types, composition and function. Structure and function of flagella, fimbriae and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials -olyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions. Nuclear material - bacterial chromosomes and bacterial plasmids.

**Unit II Microbial Classification-**Microbial Taxonomy - Definition and systematics, Nomenclature and identification.Haeckel's three kingdom classification, Whittaker's five kingdom approach. Three domainclassification; Taxon, species, strain, type culture; Major characteristics used in taxonomy – morphological, physiological, metabolic, serological and molecular.Phylogenetic relationships – Cladogram, Dendrogram; Classification and salient features of bacteria according to Bergey's Manual of Determinative Bacteriology (9th edition).

**Unit III Fungi and Viruses-**Fungi: Classification of fungi based on Alexopoulos system. - characteristics of Fungi –Filamentous, non-filamentous and dimorphic fungi -Morphology, structure and life cycle of Aspergillus niger and Saccharomyces cerevisiae. Parasitism, mutualism and symbiosis with plants and animals. Industrial uses of yeast and moulds. Viruses: ICTV system of classification, General properties, Morphology and ultra-structure of virus - capsid and their arrangements, types of envelopes and their composition, viral genome (RNA, DNA);Viroids, Prions - structure and importance.

**Unit IV Algae and Protozoans**

Classification of Algae based on Fritsch system – General characters of Blue- green Algae,(Cyanobacteria) Macroalgae - Biological and Economic importance of algae. Protozoa,– structural characteristics, classification and reproduction.

**Unit V Cultivation methods of microbes**

Isolation of different types of bacteria - Fungi – Actinomycetes - Cyanobacteria - Protozoa.Physical and Chemical requirements for growth; Pure culture methods. Anaerobic culture techniques. Preservation methods of microbes. Type culture collections. Physical and chemical methods of controlling microorganisms.

**COS**

- Understand the importance and history of Microbiology
- Demonstrate the Microscope and staining techniques
- Explain the growth and control of microorganisms
- Describe the culture media and culture techniques
- Outline the sterilization techniques

**Mapping of CO with PO and PSO**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB12.1 | 3 | 3 | 1 | 2 | - | 3 | 3 | 3 | 2 | 3 |
| P16MB12.2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| P16MB12.3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| P16MB12.4 | 2 | 3 | - | 2 | 3 | 3 | - | 2 | 3 | 2 |
| P16MB12.5 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | - | 2 |
| AVERAGE | 3.4 | 2.6 | 1.6 | 2.6 | 2 | 2.8 | 2.2 | 2.6 | 2.2 | 2.4 |

1"–Slight (Low) Correlation,"2" – Moderate (Medium) Correlation,"3"–
Substantial (High) Correlation,"-"indicatesthereisnocorrelation

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## CORE COURSE III -VIROLOGY

## OBJECTIVE

The course is designed to develop the student with enough knowledge about general, account of viruses, bacteriophages, plant, animal and human viral diseases. To train up the student in gaining knowledge about instrumentation relevant to virology

### Unit I General Virology

Terminologies , Discovery, nomenclature, classification and properties of viruses,Morphology and ultra structure – capsid and their arrangement, envelope - types and their composition, viral genome – types and structure. Sub viral agents- viroids, prions,virusoids and satellite viruses.

### Unit II General Methods of Diagnosis and Serology

Characterization and Cultivation of viruses- Embryonated eggs, Primary and secondary cell cultures, monolayer cell cultures- cell strains, cell lines and transgenic system. Serological,methods- haemagglutination, haemagglutination inhibition, complement fixation,immunofluorescence, ELISA, RIA and assay of viruses.

### Unit III Microbial Viruses

Bacteriophages- one step growth curve, Life cycle- Lytic and Lysogenic, Classification,Morphological groups - virulent dsDNA phage, ssDNA phage, phage lambda, Temperate and Transposable phage, Phage Mu, M13, T4, P1, Bacteriophage typing, Phage therapy,(bacteriophage therapy), Cyanophages, Mycoviruses (Mycophages), Rhizobiophages.

### Unit IV Animal and Human Viruses

Classification, Multiplication, Epidemiology, Pathogenesis, Diagnosis, Prevention and Treatment of animal viruses- DNA containing viruses- Papovavirus, Simian Virus – 40,(SV40), Adenoviruses, Herpes viruses, Pox viruses. RNA containing viruses- Picornavirus,Togaviruses (Arboviruses), Rhabdoviruses, Orthomyxoviruses, Reoviridae, Retroviridae,Human Immuno Deficiency virus (HIV), SARS, Influenza viruses and Emerging viruses.Viral Vaccines, Interferon and Antiviral drugs.

### Unit V Plant Viruses

History, Classification and nomenclature of plant viruses, Transmission, Multiplication,symptoms and control of plant viral diseases- Tobamo virus group, Potex virus, Poty virus,Tymo virus, Tomato spotted wilt, Cauliflower mosaic virus, Potato leaf roll virus, Rice,tungro virus, Mosaic disease of sugarcane.

**COS**

- Explain the general account of viruses
- Elaborate the bacteriophages and its types
- Describe the plantviruses
- Understand about animal and human viral diseases
- Correlate the Instrumentation relevant to virology

**Mapping of CO with PO and PSO**

| COS | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB13.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB13.2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| P16MB13.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | - | 3 | 3 |
| P16MB13.4 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| P16MB13.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | - |
| AVERAGE | 2.4 | 2.8 | 2.6 | 2.8 | 2.8 | 2.6 | 2.4 | 2.2 | 2.8 | 2.4 |

1"–Slight (Low) Correlation,"2" – Moderate (Medium) Correlation,"3"–
Substantial (High) Correlation,"-"indicatesthereisnocorrelation

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## CORE COURSE IV GENERAL BIOCHEMISTRY

## OBJECTIVES

To provide basic understanding of Cell and its function, chemical nature of biological macromolecules, metabolism and mechanism of molecular recognition including control.

### Unit I Cell and its function

Composition of living matter. Biochemistry of bacterial, animal and plant cell. Specialized components of microorganisms and their structure and function.

### Unit II Enzymes

Enzymes as biocatalysts, enzyme classification, specificity, active site, unit activity,isozymes. Enzyme kinetics: Michaelis – Menton equation for simple enzymes. Enzyme inhibition.

### Unit III Types of macromolecules and their biosynthesis

Structural features and chemistry of macromolecules. Nucleic acid – properties,biosynthesis of purines and pyrimidines - Structure of DNA and RNA. Proteins –classification – aminoacids - primary-secondary-tertiary – quaternary and three dimensional structure of proteins. Carbohydrates - mono, di, oligo and polysaccharides.Lipids and biomolecules: Fatty acids, properties, -oxidation - biosynthesis of cholesterol.

### Unit IV Bioenergetics

Bioenergetics and strategy of metabolism - flow of energy through biosphere, strategy of energy production in the cell. Oxidation – reduction reactions, coupled reactions and group transfer. ATP production, structural features of biomembranes, transport, free energy and spontaneity of reaction, G, G°, G’ and equilibrium. Basic concepts of acids, base, pH,and buffers.

### Unit V Metabolism – basic Concepts

Cell metabolism - catabolic principles and break down of carbohydrates, lipids, proteins.and nucleic acids - vitamins and their role as coenzymes.

**COS**

- Outline the composition of living matter
- Explain the enzymes and their working mechanism
- Elaborate the types of macromolecules
- Describe the concept of Bioenergetics
- Illustrate the basics of metabolism

**Mapping of CO with PO and PSO**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB14.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB14.2 | 3 | 3 | 2 | 3 | - | 2 | 2 | 3 | 3 | 3 |
| P16MB14.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| P16MB14.4 | 2 | 3 | - | 3 | 2 | 3 | 2 | 3 | - | 3 |
| P16MB14.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | - |
| AVERAGE | 2.4 | 2.8 | 2 | 2.8 | 2.2 | 2.6 | 2.4 | 2.6 | 2.2 | 2.4 |

1"–Slight (Low) Correlation,"2" – Moderate (Medium) Correlation,"3"–
Substantial (High) Correlation,"-"indicatesthereisnocorrelation

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## CORE PRACTICAL I-FUNDAMENTALS OF BIOLOGICAL SCIENCES, GENERAL MICROBIOLOGY, VIROLOGY, GENERAL BIOCHEMISTRY (P)

### Fundamentals of Biological Sciences

Stem and root sections of a monocot and a dicot plant

Demonstration of computer program- Vertebrate Dissection Guides: The Frog.

### General Microbiology

Principles and methods of sterilization  Direct microscopic observations of bacterial shape- cocci, rods and chains; fungal spore- mycelium, yeast budding

Preparation of media: Nutrient broth, Nutrient agar, plates, slants and soft agar

Micrometry - counting and measurements

Pure techniques - serial dilution - pour plate, spread plate, streak plate methods and stab culture techniques

Bacterial Staining methods - simple, Gram's, acid fast, flagella, capsule and spore.

Fungal Staining methods - Lacto-phenol cotton blue

Motility of bacteria

Enumeration of bacteria/ yeast cell; viable count (plate count) , total count (Haemocytometer)

Isolation and purification of cyanobacteria, actinomycetes and fungi

### Virology

Isolation and characterization of bacteriophage and cyanophage from natural resources

Phage titration – T4 phage

Study of virus infected plant samples- animal tissue culture- chick embryo fibroblast culture preparation

Transmission methods – mechanical

### General Biochemistry

Preparation of buffer (Tris, phosphate, acetate buffer)

Determination of (H+)ion concentration

Verification of Beer-Lambert's law using coloured solution

Preparation of standard graph for the following and estimating the concentration in a microbial sample i) glucose –anthrone method, ii) bovine serum albumin (Lowry's method) and iii) Nucleic acid – DNA (diphenylamine method), RNA (Orcinol method).

Separation of aminoacids by paper chromatography and identifin of aminoacid

Separation of proteins by PAGE, SDS – PAGE – Demonstration.

**CO**

- Demonstrate the principles and methods of sterilization
- Explain the microscopical features of microbes
- Describe the preparation of various media and the inoculation methods
- Clarify the pure culture techniques
- Illustrate the isolation and characterization of bacteriophages

| Cos | PSO1 | PSO2 | PSO3 | PSO 4 | PSO 5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **P16MB15P** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |
| **AVERAGE** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |

1"–Slight (Low) Correlation,"2" – Moderate (Medium) Correlation,"3"–Substantial (High) Correlation,"-"indicatesthereisnocorrelation


**CORE COURSE VII-MOLECULAR BIOLOGY AND MICROBIAL GENETICS**

**OBJECTIVES**

In addition to the most essential fundamentals of the subject, the paper aims to impart the current updated knowledge on molecular genetics of prokaryotes. It also endeavours to provide the required fundamental details on eukaryotic molecular genetics.

**Unit I -Genetic material, DNA replication and repair**

Identification of genetic material (Griffith, Avery and Hershey and Chase experiments).Organization of genetic material: Bacteria – Eukaryotes: nucleus and nucleosomes, lampbrush and giant chromosomes. DNA replication - Meselson – Stahl experiment,Molecular mechanisms of DNA Replication – bidirectional and rolling circle replication.Differences between prokaryotic and eukaryotic replication. Plasmids – types, structure and replication. Inhibitors of DNA replication - DNA repair – mechanism of excision repair,SOS repair and mismatch repair.

**Unit II- Transcription and translation**

Process of transcription – initiation, elongation – termination. Synthesis of mRNA in prokaryotes and eukaryotes. RNA splicing. Synthesis of rRNA and tRNA. RNA processing –capping and polyadenylation. Inhibitors of transcription. Genetic code, process of translation – initiation, elongation and termination. Signal sequences and protein-transport. Inhibitors of translation.

**Unit III- Regulation of gene expression**

Organization of Genes in Prokaryotes and Eukaryotes - Introduction - Operon concept, lac,trp, arabinose operons, promoters and repressors. Regulation of gene expression –Transcriptional control – promoters, terminators, attenuators and anti terminators;Induction and repression; Translational control – ribosome binding, codon usage,antisense RNA; post-transcriptional gene silencing – RNAi.

**Unit IV -Gene transfer and genetic recombination mechanisms**

Transformation – competence cells, regulation, general process; Transduction – general and specialized; Conjugation – Discovery, mechanism of F+ v/s F-, Hfr+ v/s F-, F' v/s F- ,triparental mating, self transmissible and mobilizable plasmids, pili. Linkage and genetic maps – genetic mapping of T4 phage. C- value paradox. Hardy Weinberg Equilibrium.

**Unit V- Mutation and transposable elements**

Types and molecular basis of mutation– Agents of mutation - Importance of mutations in evolution of species. Discovery of insertion sequences, complex and compound transposons – T10, T5, and retroposon – Nomenclature- Insertion sequences – Mechanism – Transposons of E. coli, Bacteriophage and Yeast. Importance of transposable elements in horizontal transfer of genes and evolution.

**CO**

CO 1-Understand the basics of genetics.

CO 2-Explain the structure and chemical nature of DNA and RNA.

CO 3-Elaborate the replication methods of DNA and RNA.

CO 4-Describe the process of transcription and translation.

CO 5-Clarify the various methods of bacterial reproduction, Comprehend the mutation and its types.

**Mapping of CO with PO and PSO**

| COS | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB31.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB31.2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| P16MB31.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| P16MB31.4 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| P16MB31.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.4 | 2.8 | 2.6 | 2.8 | 2.8 | 2.6 | 2.4 | 2.6 | 2.8 | 3 |

"1" – Slight (Low) Correlation "2"–oderate(Medium)-Correlation "3" – Substantial (High) Correlation "-"indicates there is no correlation

**CORE COURSE VIII-IMMUNOLOGY**

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**OBJECTIVES**

The aim of the course is to teach the types of immunity, immune system, antigen,antigen - antibody reaction, T and B cell activation, lymphokines and cytokines, hyper sensitivity reaction, immune deficiency disorders, immunohematology and transplantation of immunity.

**Unit I Immune system**

History of Immunology, Types of immunity- innate and acquired. Humoral and cell mediated immunity. Central and peripheral lymphoid organs- Thymus, bone marrow,spleen, lymph nodes and other peripheral lymphoid tissues GALT. Haematopoiesis, Cells of the immune system- lymphocytes, mononuclear phagocytes- dendritic cells, granulocytes. NK cells and mast cells, cytokines.Unit II T and B cell, Antigen –antibody reactions T and B-cell receptors, Antigen recognition- processing and presentation to T- cells.Interaction of T and B cells. Antigen and antibody – properties, types and functions. Antigen –antibody reactions - Precipitation, agglutination, complement fixation, RIA, ELISA,Western blotting and immunofluorescence.

**Unit III T and B cell activation**

B cell receptor complex, B cell maturation, antibody diversity, understanding self – non self discrimination, TH cell subpopulation, organization of T cell receptor, cell mediated effectors responses. Complement system: Basics of complement protein – different pathways of complement activation - classical and alternative.

**Unit IV MHC, Cytokines and Lymphokines** Structure of MHC molecules- Human Leucocyte Antigen- Functions of MHC. Cytokine and lymphokines structure and their receptors. Hypersensitivity reaction and their types. Auto immune disorders, transplantation and cancer immunology

**Unit V Immunotechnology and its applications** Production of polyclonal, monoclonal antibodies and phage display - techniques and applications. Immunization practices- active and passive immunization. Vaccines- killed and attenuated, recombinant vaccines, DNA and peptide vaccines. Applications of immunotechniques – Flow cytometry, Immunoelectron microscopy, Immunohistochemistry and Bioplex array.

**CO**

CO 1-Acquire the knowledge on the Immune system

CO 2-Understand the Immunity and its types.

CO 3-Explain the Antigen and Antibody types

CO 4-Describe the Antigen-antibody reactions

CO 5-Demonstrate the Hypersensitivity reactions and its types.

**Mapping of CO with PO and PSO**

| **COS** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB32.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB32.2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |
| P16MB32.3 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 3 |
| P16MB32.4 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 |
| P16MB32.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.4 | 2.8 | 2.6 | 2.6 | 2.8 | 2.4 | 2.4 | 2.6 | 2.6 | 2.8 |

"1" – Slight (Low) Correlation "2"–oderate(Medium)-Correlation "3" – Substantial (High) Correlation "-"indicates there is no correlation

**CORE PRACTICAL III-MOLECULAR BIOLOGY AND MICROBIAL GENETICS, IMMUNOLOGY (P)**

**Microbial Genetics and Molecular Biology**

 Isolation of antibiotic resistant microbes

 Isolation of mutants by spontaneous mutation – Gradient plate technique

 Isolation of auxotrophic and antibiotic resistant mutants by physical and chemicalmutagens

 Competent cell preparation and Bacterial transformation

 Generalized transduction in E. coli.

 Isolation of microbial genomic DNA

 Isolation of plasmids from E.coli (mini preparation).

 Characterization of plasmid DNA by agarose gel electrophoresis.

 Restriction digestion and Ligation of DNA

 Polymerase Chain Reaction

 Blotting techniques (Southern, Northern, Western and Dot blottings)

**Immunology**

 Collection of venous blood from human and separation, preservation and storage of serum/plasma

 Identification and enumeration of RBC, WBC and total cell count.

 Estimation of Haemoglobulin content

 Agglutination reactions - blood grouping and WIDAL (slide and tube tests)

 Immunoelectrophoresis – Graber and William's technique.

 Counter- current immuno electrophoresis

 Précipitation reaction – Ouchterlony's Double Immuno Diffusion technique.

 Serum electrophoresis

 Enzyme Linked Immunosorbent Assay (ELISA)

 Handling of Laboratory animals and raising antibodies.

 Dissection of primary and secondary lymphoid organs in a selectedlaboratory animal

**CO**

- Identify the blood groups and Rh typing
- Understand the types of blood cells
- Explain the isolation of genomic DNA and plasmid DNA from bacteria
- Describe the isolation of protein
- Demonstrate the blotting techniques

| Cos | PSO1 | PSO2 | PSO3 | PSO 4 | PSO 5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB33P | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |

"1" – Slight (Low) Correlation "2"–oderate(Medium)-Correlation "3" – Substantial (High) Correlation "-"indicates there is no correlation


**ELECTIVE COURSE -MARINE MICROBIOLOGY**

**OBJECTIVES**

This subject aims to introduce the students to understand microbial diversity, significance,dynamics of marine environment, Marine food borne pathogens, and marine microbial products.

**Unit I Marine Microbial Habitats and Diversity**

Marine environment–properties of seawater , chemical and physical factors of marine environment-Ecology of coastal, shallow and deep sea microorganism - significance of marine microflora. Diversity of microorganism - Archaea, bacteria, actinobacteria,cyanobacteria, algae, fungi, viruses and protozoa in the mangroves and coral environments - Microbial endosymbionts – epiphytes - coral-microbial association,sponge-microbial association.

**Unit II Cultivation of Marine microbes and Nutrient cycling.**

Methods of studying marine microorganisms- sample collection- isolation and identification: Cultural, Morphological, physiological, biochemical and Molecular characteristics- Preservation methods of marine microbes. Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments and mangroves.

**Unit III Marine extremophiles and Bioremediation**

Survival at extreme environments – starvation – adaptive mechanisms in thermophilic,alkalophilic, osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles, halophiles and their importance. Microbial consortia and genetically engineered microbes in bioremediation of polluted marine sites - heavy metals and crude oil. Biofouling and their control.

**Unit IV Seafood microbiology**

Pathogenic microorganisms, distribution, indicator organisms, prevention and control of water pollution, quality standards, International and National standards. Microbiology of processed finfish and shellfish products. Rapid diagnosis of contamination in seafoods and aquaculture products.

**Unit V Marine microbial products**

Marine microbial products – Carrageenan, agar-agar, sea weed fertilizers – Astaxanthin, β carotene – enzyme – antibiotics – antitumour agents-polysaccharide – biosurfactants and pigments. Preservation methods of sea foods. Quality control and regulations for microbial quality of fishes, shellfish and Marine living resources used for food and drugs

**CO**

CO 1-Understand the marine habitats and diversity of microbes.

CO 2-Explain the cultivation of marine microbes and the nutrient cycling.

CO 3- Elaborate the sea food microbiology.

CO 4-Demonstrate the marine microbial products.

CO 5-Explain the marine extremophiles.

**Mapping of CO with PO and PSO**

| Cos | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MBE3B.1 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MBE3B.2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| P16MBE3B.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 |
| P16MBE3B.4 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| P16MBE3B.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.4 | 2.8 | 2.4 | 2.8 | 2.8 | 2.8 | 2.4 | 2.8 | 2.8 | 2.8 |

"1" – Slight (Low) Correlation "2"–Moderate(Medium)Correlation "3" – Substantial (High) Correlation
"-" indicates there


**ELECTIVE COURSE-GENETIC ENGINEERING**

**OBJECTIVES**

To impart the learners with the advanced knowledge and growing significance of genetic and protein engineering/ DNA cloning. To educate the students with the advanced tools, techniques and methods employed in DNA/ gene cloning and expression as well as in protein engineering strategies.

**UNIT I Introduction to gene cloning strategies**

Gene cloning: Steps - Isolation and purification of nucleic acids (genomic DNA, RNA and Plasmids) – Methods of handling and quantification of DNA and RNA. Analyses of DNA/RNA and proteins: Agarose Gel and SDS – PAGE - Blotting – types of blotting – Southern,Northern and Western Blotting. Chromosome walking.

**UNIT II Tools and methods in gene cloning**

Restriction endonucleases – nomenclature, classification and characteristics – DNA,methylases – DNA polymerases - Ligases – Adapters, Linkers and Homopolymer tailing –Gene transfer techniques: electroporation, microinjection, protoplast fusion and microparticle bombardment – Screening for recombinants: Direct: Insertional inactivation, plaque phenotype and indirect methods: Immunochemical detection, nucleic acid hybridization, Dot and Colony Blotting. Methods of DNA cloning. Construction and applications of Genomic DNA and cDNA libraries.

**UNIT III Gene cloning vectors for prokaryotes and eukaryotes**

Cloning Vectors – properties - types of vectors – plasmids – host range and incompatibility – plasmids vectors for cloning in E. coli (pBR322 and derivatives, pUC vectors and pGEM3Z) - Vectors constructed based on bacteriophages (M13 and Lambda), cosmids,phasmids, phagemids and BACs - Eukaryotic vectors - Yeast vectors – animal and plant,vectors – expression vectors: E. coli lac and T7 phage promoter based vectors – shuttle,vectors - Expression of foreign genes in bacteria, animal, plant, algae and fungi –merits and demerits.

**UNIT IV Techniques in genetic engineering**

Characterization of cloned DNA: Restriction mapping - restriction fragment length,polymorphism (RFLP) - Polymerase chain reaction (PCR) – Principles,types and their applications. DNA sequencing: Primer walking, Chemical method:Maxam and Gilbert method, Sanger's method: traditional (dideoxy) and automated sequencing methods. Pyrosequencing – DNA chips and micro array.

**UNIT V Protein engineering and techniques**

Site directed mutagenesis – methods - Design and construction of novel proteins and enzymes, Basic concepts in enzyme engineering, engineering for kinetic properties of enzymes. protein folding, protein sequencing, protein crystallization. Data analysis – Mass sectrometry based

methods for protein identification, MALDI-TOF, 2D gel electrophoresis– Applications of protein engineering: Examples of engineered proteins.

**CO**

- Illustrate the tools and techniques in r DNA technology
- Discuss the handling and applications of different DNA and RNA modifying enzymes
- Explain the construction of genomic and DNA library
- Identify the problems associated with the production of recombinant proteins
- Demonstrate various applications of r DNA technology
- Clarify the environmental applications of Genetic Engineering through bioremediation

| Cos | PSO 1 | PSO2 | PSO 3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MBE4B.1 | 3 | 2 | - | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| P16MBE4B.2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 3 | 3 |
| P16MBE4B.3 | 3 | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 2 |
| P16MBE4B.4 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| P16MBE4B.5 | 2 | 3 | 2 | 2 | 1 | 2 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.6 | 2.4 | 2 | 2.2 | 2.2 | 2 | 2.4 | 2.4 | 2.8 | 2.8 |

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## DEPARTMENT OF MICROBIOLOGY

### M.Sc., Microbiology

**Programme Outcomes:**

Develop professional foundations through activities such as teaching, internship and fellowships.
* Attained profound Expertise in Discipline
* Acquire the basic tools needed to carry out independent research.
* Proficient in their specialized area and successfully complete an advanced research project.
* Develop skills in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
* Acquired ability to function in Multidisciplinary Domains

**Programme Specific Outcomes:**

1. Understand the nature and basic concepts of Microbiology
2. Analyse the relationships of microorganisms with other organisms
3. Explain the applications of microbiology in Agriculture, medicine and Environment
4. Expertise both theoretical and practical aspects of the microbiology discipline
5. To contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level

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## CORE COURSE V- MICROBIAL PHYSIOLOGY

### OBJECTIVES

To understand the growth, enzymology and physiological processes of microbes

### Unit I Cell structure and function

Bacterial cell wall - Biosynthesis of peptidoglycan - outer membrane, teichoic acid – Exopolysaccharides; cytoplasmic membrane, pili, fimbriae, S-layer. Transport mechanisms– active, passive, facilitated diffusions – uni, sym, antiports. Electron carriers – artificial electron donors – inhibitors – uncouplers – energy bond – phosphorylation.

### Unit II Microbial growth

Bacterial growth - Phases of growth curve – measurement of growth – calculations of growth rate – generation time – synchronous growth – induction of synchronous growth,synchrony index – factors affecting growth – pH, temperature, substrate and osmotic condition. Survival at extreme environments – starvation – adaptative mechanisms in thermophilic, alkalophilic, osmophilic and psychrophilic.

### Unit III Microbial pigments and photosynthesis

Autotrophs - cyanobacteria - photosynthetic bacteria and green algae – heterotrophs –bacteria, fungi, myxotrophs. Brief account of photosynthetic and accessory pigments –chlorophyll – fluorescence, phosphorescence - bacteriochlorophyll – rhodopsin – carotenoids – phycobiliproteins.

### Unit IV Carbon assimilation

Carbohydrates – anabolism – autotrophy – oxygenic – anoxygenic photosynthesis – autotrophic generation of ATP; fixation of CO2 – Calvin cycle (C3) – C4 pathways.Respiratory metabolism – Embden Mayer Hoff pathway – Entner Doudroff pathway –glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle – gluconeogenesis – Fermentation of carbohydrates – homo and heterolactic fermentations.

**Unit V Spore structure and function-**Cell division – endospore – structure – properties – germination. Microbial sporulation and morphogenesis – Bacteria including cyanobacteria and actinobacteria, fungi and algae.

**CO**

CO 1-Explain the nutrition and growth of microorganisms.

CO 2-Illustrate the bacterial enzymes, classification and their properties.

CO 3-Describe the metabolism of carbohydrates, proteins and lipids.

CO 4-Understand the anaerobic respiration.

CO 5-Demonstrate the fermentation.

**Mapping of CO with PO and PSO**

| COS | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB21.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB21.2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| P16MB21.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| P16MB21.4 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| P16MB21.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.4 | 2.8 | 2.6 | 2.6 | 2.8 | 2.6 | 2.4 | 2.6 | 2.8 | 3 |

1" – Slight (Low) Correlation 2"–Moderate(Medium)Correlation "3" – Substantial (High) Correlation,"-" indicates there is no correlation

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## CORE COURSE VI -ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

### OBJECTIVES

To enable the students to get exposure on various aspects of environmental and agricultural microbiology

### Unit I Air microbiology and Biogeochemical cycles

Aerobiology- Significance of air microflora - Microbial air pollution- sources, biological indicators and effects on plants and human beings. Enumeration of bacteria from air, Air sampling devices, Outline of Airborne diseases (Bacterial, Fungal and Viral), Air sanitation.Biogeochemical cycles -Nitrogen, Carbon, Phosphorous, Sulphur, Iron and their importance.

### Unit II Aquatic microbiology

Microbes in marine and fresh water environment – eutrophication – Water pollution –sources and nature of pollutants in water – sewage – treatment of liquid waste –primary, secondary and tertiary treatment – water borne diseases – Assessment of water quality – BOD and COD. Solid waste treatment– saccarification and pyrolysis.

### Unit III Recycling of Liquid and Solid wastes

Recycling of Liquid and Solid wastes-Composting-Biogas, Mushroom and SCP production from waste. Biodegradation of complex polymers (Cellulose, Hemicellulose, Lignin,Chitin and Pectin), Bioremediation (In-situ, Ex-situ, Intrinsic), Bioaugmentation and Biostimulation. Bioleaching (Copper and Uranium) -Xenobiotics degradation (Heavymetals). A brief note on panchakavya.

### Unit IV Soil Microbiology

Microbial association with plants - Phyllosphere, Rhizosphere, Mycorrhizae, nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – phosphate solubilizers –application of biofertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in Rhizobium.

### Unit V Plant diseases and its control

Bacterial, viral and fungal plant pathogens. Morphological, physiological changes with reference to disease establishment in plants – plant protection – phenolics – phytoalexins and related compounds. Disadvantages of chemical pesticides. Microbial pesticides- types,mechanisms, advantages and limitations.

**CO**

CO 1-Understand the microorganisms in the Rhizosphere and phylloplane zones.

CO 2-Explain the various plant disease.

CO 3-Demonstrate the aero microbiology

CO 4-Elaborate the methods of waste dispo

CO 5-Describe the commercial aspects of soil microbiology.

**Mapping of CO with PO and PSO**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB22.1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| P16MB22.2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | - | 3 |
| P16MB22.3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| P16MB22.4 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 3 | 2 |
| P16MB22.5 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | - | 2 | 2 |
| AVERAGE | 2.8 | 2.6 | 2.2 | 2.4 | 2.6 | 2.8 | 2.6 | 2 | 2 | 2.4 |

"1" – Slight (Low) Correlation "2"–Moderate(Medium)Correlation
"3" – Substantial ( High) Correlation"-" indicates there is no correlation

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## CORE PRACTICAL II-MICROBIAL PHYSIOLOGY, ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY (P)

### Microbial Physiology

 Bacterial growth curve – Turbidity method

 Effect of temperature, pH and salinity on bacterial growth

 Starch, casein, gelatin and lipid hydrolysis tests

 Biochemical tests: IMViC, TSI, Urease, Catalase, Oxidase, Hydrogen sulphide, coagulase, nitrate reduction tests

 Carbohydrate fermentation test

### Environmental and Agricultural Microbiology

 Enumeration of Microbial population from rhizosphere and Non-rhizosphere soil

 Localization of Arbuscular Mycorrhizae (AM)

 Isolation of Azospirillum and Azotobacter from soil

 Isolation of Rhizobium sp. from root nodules of legumes

 Isolation of phosphate solubilizing bacteria from soil

 Isolation of Cyanobacteria from agricultural soil and water

 Isolation of bacterial and fungal pathogens from plants

 Isolation and identification of air-borne microbes using Andersen sampler.

 Determination of BOD and COD of polluted and pond water.

 Assessment of water quality by MPN technique

 Demonstration of the plant diseases: a) Tobacco mosaic; b) Bacterial blight of paddy;

c)Downy mildew of bajra; d) Powdery mildew of cucurbits; e) Head smut of sorghum; f)Red rot of sugar cane.

**CO**

- Explain the microbial growth and its optimization
- Describe the biochemical characterization of bacteria
- Demonstrate the carbohydrate fermentation
- Expertise in the isolation of bacteria and algae
- Demonstrate the microbial diseases of plants

| Cos | PSO1 | PSO2 | PSO3 | PSO 4 | PSO 5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| **P16MB23P** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

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## ELECTIVE COURSE-FOOD AND DAIRY MICROBIOLOGY

## OBJECTIVES

To make the students to learn about microbial illness in foods and importance of microbial fermented foods.

### Unit I Food and microbes

Types of microorganisms in food – Bacteria, molds, yeast and protozoa. Source of contamination-Factors influencing microbial growth in food.

### Unit II Food fermentation

Food fermentations: methods of fermentations and organisms used -Cheese, bread, wine,beer. Fermented vegetables. Food and enzymes from microorganisms - single cell protein and mushrooms. Prebiotics, Probiotics and synbiotics. Advantages of probiotics.

### Unit III Fermented food products

Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, vegetables, fruits, meat and meat products, Fish and other sea foods, egg and poultry, dairy and fermentative products (ice cream).

### Unit IV Food preservation method

Food preservations: principles- methods of preservations- Physical and chemical methods. Canning: classification of can, structure of cans, canning of food items, Thermal process time calculations for canned foods.

### Unit V Food borne diseases and control

Food borne diseases and food poisoning. General principles underlying food spoilage and contamination – Staphylococcus, Clostridium, Escherichia coli and Salmonella nfections,Hepatitis, Amoebiosis and Mycotoxins. Spoilage in canned foods. Food sanitation and control measures, HACCP, GMP, GLP.

**CO**

CO 1-Understand the microflora of the food

CO 2-Describe the food and nutrients concept

CO 3-Explain the food fermentation and dairy production

CO 4-Clarify the food contamination.

CO 5-Elaborate the food borne diseases and food poisoning.

**Mapping of CO with PO and PSO**

| COS | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MBE1B.1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MBE1B.2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |
| P16MBE1B.3 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |
| P16MBE1B.4 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| P16MBE1B.5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.4 | 2.8 | 2.6 | 2.8 | 2.8 | 3.2 | 2.4 | 2.6 | 2.8 | 3 |

"1" – Slight (Low) Correlation
"2"–Moderate(Medium)Correlation
"3" – Substantial (High) Correlation
"-"indicates there is no correlation

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## ELECTIVE COURSE -QUALITY CONTROL AND IPR

## OBJECTIVES

To gain knowledge about intellectual property rights, copyrights, trademarks and geographical limitation. Explain various concepts of biotechnological inventions and their commercialisation. Ethics of biological Goods manufacturing practice, usage of animals, plants and their biosafety assessment.

### Unit I Bioethics

Legality, Morality and Ethics, the principles of bioethics, autonomy, human rights, beneficience,privacy, justice and equality.

### Unit II Biosafety

Concept and issues, rational vs subjective, perceptions of risk and benefits of Biosafety.Biosafety concern levels – Individual, institution, society, region, country and world- Lab associated Infections.

### Unit III Biosafety Assessment (BSA)

BSA of biotechnology and pharmaceutical products such as drugs, vaccines and biomolecules.

### Unit IV Quality Control

Quality control in food process technology- WHO Standards- Quality Control in Dairy product technology- Quality control in portable water.

### Unit V IPR

GATT and IPR, IPR in India, WTO Act, Convention on Biodiversity (CBD), patent cooperation treaty,(PCT), forms of patents and patentability, process of patenting, Indian and international agencies,involved in IPR and patenting, Global scenario of patents and India’s position, patenting of biological material, GLP and GMP.

**CO**

CO 1-Understand the IPR and its types.

CO 2-Explain the concepts of biotechnology inventions and their commercialization

CO 3-Explain the biological good manufacturing practices

CO4- Analyse the bio safety assessment.

CO5-Study the concept of Quality control

**Mapping of CO with PO and PSO**

| COs | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MBE2B.1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 2 | 3 |
| P16MBE2B.2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 |
| P16MBE2B.3 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 |
| P16MBE2B.4 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 2 |
| P16MBE2B.5 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| AVERAGE | 2.8 | 2.6 | 2.2 | 2.6 | 2.6 | 2.8 | 2.8 | 2.6 | 2.6 | 2.4 |

## CORE COURSE IX MEDICAL MICROBIOLOGY

### OBJECTIVES

To impart and explain the students with the advanced knowledge on the characteristics of medically important human microbial pathogens with focus on the diseases caused by them,disease pathogenesis, lab diagnosis, prophylaxis, control etc.

### UNIT I Introduction to Medical Microbiology

Significance of Microbiology in Medicine, Classification of medically important microbes, Normal microbial flora of the human body: normal flora of skin, eye, throat, gastrointestinal tract and urogenital tract - Infections- Sources, types – opportunistic, nosocomial and community acquired infections - Mode of transmission, carriers and their types – investigation of epidemic diseases.

### Unit II Medical Bacteriology

Morphological, cultural and biochemical characteristics of and epidemiology, mechanism of bacterial pathogenesis, lab diagnosis, prophylaxis and control of medically important diseases caused by: Staphylococcus aureus, Group A Streptococci, Corynebacterium diphtheriae, Clostridium tetani, Bacillus anthracis, Leptospira interrogans, Treponema pallidum, Mycobacterium tuberculosis,Escherichia coli, Vibrio cholerae, Niesserriae, Haemophilus influenza, Helicobacter pylori,Pseudomonas and Salmonella. Brief note on Chlamydia, Rickettsia Mycoplasama, anaerobic bacterial infections, Atypical Mycobacterium, Zoonotic bacterial pathogens, Antibiotic susceptibility test:Kirby – Bauer disk diffusion method.

### Unit III Medical Mycology

Morphological and cultural characteristics of and epidemiology, mechanism of fungal pathogenesis,lab diagnosis and treatment of medically important diseases caused by: Superficial mycosis – Tinea versicolor. Cutaneous mycoses: Microsporum, Trichophyton, Epidermophyton. Subcutaneous mycoses: Sporotrichosis, Chromoblastomycosis, Zygomycosis. Systemic Mycoses – Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Coccidioides immitis,Paracoccidioides brasiliensis. Opportunistic mycoses: Candidiasis, Cryptococcosis and Aspergillosis.Antifungal susceptibility testing.

### Unit IV Medical Virology

General properties of and epidemiology, pathogenesis, lab diagnosis and treatment of medically important viral diseases caused by: Influenza viruses, Measles, Mumps, Rubella, Chicken Pox,Hepatitis A,B,C, Dand E, Poliomyelitis, HIV, Human Papilloma Virus, Rabies, Yellow fever, Dengue and Japanese Encephalitis viruses. Brief note on oncogenic viruses.

**Unit V Medical Parasitology and emergence of antibiotic resistant pathogens**

Morphology of, and pathogenesis, laboratory diagnosis and treatment of medically importantprotozoan diseases caused by: Entomoeba histolytica, Giardia lamblia, Trichmonas vaginalis,Plasmodium vivax, Leishmania donovani, Taenia solium, Ascaris lumbricoides, Ancyclostoma duodenale and Wuchereria bancrofti. Brief note on the emergence of MDR bacterial, fungal pathogens, extremely drug resistant (XDR) pathogens and superbugs.

**CO**

- Clarify the epidemiology of bacterial, fungal and protozoan infections
- Describe the life cycle, pathogenesis, and diagnosis of viral infections
- Explain the methods of cultivation of pathogenic bacteria
- Identify the modes of bacterial, fungal and protozoan infections
- Elaborate the normal flora of humans
- Determine the antibiotic resistance in bacteria

| Cos | PSO1 | PSO 2 | PSO3 | PSO4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB41.1 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| P16MB41.2 | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| P16MB41.3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 |
| P16MB41.5 | 2 | - | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| P16MB41.5 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| AVERAGE | 2.6 | 2 | 2.6 | 2 | 2.4 | 2.4 | 2.8 | 2.8 | 2.4 | 2.6 |

"1" – Slight (Low) Correlation "2"–Moderate (Medium)Correlation "3" – Substantial (High) Correlation
"-" indicates there

## CORE COURSE X-BIOPROCESS TECHNOLOGY

## OBJECTIVES

To learn the process involved in the industrial production of microbial products.Understand the strategies of strain selection and improvement. Understand the process of fermentation. Familiarize with types of fermentors and downstream processing. To learn the role of microbes in food preparation, preservation and spoilage. To understand the quality of food and products.

### Unit I Industrially important microbes and their improvement

Screening methods for industrial microbes – detection and assay of fermentation products– classification of fermentation types – strain selection and improvement.Mutation and recombinant DNA techniques for strain improvement. Preservation of cultures after strain improvement.

### Unit II Fermenter – types and function

Fermenters – Basic functions, design and components – asepsis and containment requirements – body construction and temperature control – aeration and agitation systems – sterilization of fermenter, air supply, and medium; aseptic inoculation methods –sampling methods, valve systems – a brief idea on monitoring and control devices and types of fermenters. Photobioreactors.

### Unit III Fermentation process

Growth of cultures in the fermenter. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch and continuous culture,specific growth rate, steady state in a chemostat, fed-batch fermentation, yield of biomass,product, calculation for productivity, substrate utilization kinetics. Fermentation process:Inoculum development. Storage of cultures for repeated fermentations, scaling up of process from shake flask to industrial fermentation.

### Unit IV Food microbiology

Microbiology of fermented milk – starter cultures, butter milk, cream, yoghurt, kafir,kumiss, acidophilus milk and cheese. Microbes as sources of food (Spirulina, Saccharomyces cerviceae, Rhizopus sp.). Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis and Campylobacter jejuni – spoilage of canned foods – Detection of spoilage and characterization. Food sanitation in food manufacture and in the retail trade;Food control agencies and their regulations.

### Unit V Legal protection and IPR

GATT and IPR, forms of IPR, IPR in India, WTO, TRIPS Convention on Biodiversity (CBD),Patent Co-operation Treaty (PCT), forms of patents and patentability, process of

patenting, Indian and international agencies involved in IPR and patenting, Global scenario of patents and India's position, patenting of biological materials.

**CO**

- Elaborate various aspects of industrial technology related to microbiology
- Screen industrially important strains
- State and explain the principles of fermenter design and computer assisted control
- Discuss fermentation process and downstream processing
- Describe industrial production of enzymes, antibiotics and aminoacids

| Cos | PSO 1 | PSO 2 | PSO3 | PSO 4 | PSO5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB42.1 | 2 | 3 | - | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| P16MB42.2 | 3 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 3 | 2 |
| P16MB42.3 | 3 | 3 | 3 | 3 | 2 | - | 3 | 3 | 3 | 2 |
| P16MB42.4 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 |
| P16MB42.5 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| AVERAGE | 2.8 | 2.2 | 2 | 2.6 | 2.6 | 2 | 2.6 | 2.4 | 2.8 | 2.8 |


**CORE PRACTICAL IV-MEDICAL MICROBIOLOGY AND BIOPROCESS TECHNOLOGY (P) MEDICAL MICROBIOLOGY**

Collection, coding and transport of clinical specimens for microbiological examinations

Isolation and identification of upper respiratory tract bacterial pathogen –Streptococcus pyogenes

Isolation and identification of Staphylococcus aureus from clinical specimen  Isolation and identification of lower respiratory tract bacterial pathogen –Pseudomonas aeuroginosa

Isolation and identification of gastrointestinal bacterial pathogens – Salmonella, Shigella andVibrio

Isolation and identification of urinary tract pathogens – E. coli and Klebsiella pnemoniae

Isolation and identification of bacterial pathogen causing enteric fever – Salmonella typhi, S.paratyphi A and B

Isolation and identification of clinically important yeast and molds - Candida albicans,Cryptococcus neoformans, Fusarium spp. and Aspergillus spp.

Antibiotic susceptibility test – Disc diffusion method (Kirby –Bauer)

Determination of MIC of any one antibiotic against any one bacterial species.

Examination of blood smears for Plasmodium spp.

Examination of faeces for parasites

**BIOPROCESS TECHNOLOGY**

Production, quantification, extraction and characterization of the following

Alcohol - Wine

Organic acid – Citric acid – Solid state and submerged fermentation.

Amino acid– Glutamic acid.

Extra cellular enzymes – Protease by submerged fermentation and Cellulase by solid statefermentation.

**CO**

- Understand the collection, transport and examination of clinical specimens
- Identify the respiratory tract infecting organisms
- Explain the pathogens from the body fluids
- Illustrate the production of industrially important products

- Elaborate the fermentation oriented products

| Cos | PSO1 | PSO2 | PSO3 | PSO 4 | PSO 5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MB43P | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 |


**Project**

**CO**

- Enhance the practical knowledge on the field

| Cos | PSO1 | PSO2 | PSO3 | PSO 4 | PSO 5 | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|---|---|---|---|---|
| P16MBPW | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| AVERAGE | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |