### NATIONAL COLLEGE (AUTONOMOUS), TIRUCHIRAPALLI – 1

**M.Sc., MICROBIOLOGY – Course Structure under CBCS**

(Applicable to the candidates admitted from the academic year 2013-2014 onwards)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper No.</th>
<th>Title of the Paper</th>
<th>Instr Hrs/Week</th>
<th>Credit</th>
<th>Exam Hrs.</th>
<th>Marks Internal</th>
<th>Marks External</th>
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<tr>
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<td>CC I</td>
<td>General Microbiology</td>
<td>6 5 3</td>
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<td>CC IV P</td>
<td>Lab work in CC-I, II, III &amp; EC-I</td>
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<td>CC V</td>
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<td>CC VI</td>
<td>Food and Dairy Microbiology</td>
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<td>Project (Dissertation 75 marks &amp; Viva Voice – 25 Marks)</td>
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There will be oral test for all practical examinations. The oral test will carry 5 marks in the external component.
GENERAL MICROBIOLOGY – P13MB1

Semester : I
Core Course: I
Instruction Hours/Week: 6
Credit: 5

Unit 1 History of microbiology

Unit 2 Microscopy – seeing the unseen
Light Microscopy – Bright field, Dark field, Phase contrast, Fluorescent and Polarization microscopes, Electron Microscopy – TEM & SEM, Confocal Microscopy - Principles and applications.

Unit 3 Microbial Taxonomy - conventional way

Unit 4 Biochemical & molecular taxonomy

Unit 5 Microbial Growth and maintenance
chemical methods – sterilization and disinfection. Maintenance and preservation of microorganism.

**References:**

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**BACTERIOLOGY** – P13MB2

**Semester : I**

**Instruction Hours/Week: 6**

**Core Course: II**

**Credit: 5**

**Unit 1 Morphology, Classification and Ultra structure of bacteria**


**Unit 2 Nutrition and nutritional types of bacteria**

**Unit 3 Bacterial nitrogen metabolism**

**Unit 4: Bacterial genetics and application**

**Unit 5 Medical Bacteriology**
Early discovery of pathogenic microorganisms. Classification of medically important microorganisms; Normal microbial flora of human body and their interaction. Major bacterial infections of human (Mycobacterium tuberculosis, Helicobacter pylori, Salmonella, Enterobacteriacea, Vibrio cholera and Treponema pallidum) and bacterial zoonotic diseases (Anthrax, Brucellosis, Psittacosis and Tularemia).
**Reference:**


**IMMUNOLOGY – P13MB3**

**Semester**: I  
**Core Course**: III  
**Instruction Hours/Week**: 6  
**Credit**: 5

**Unit 1 History of Immunology**

Historical perspective – Early discoveries (Edward Jenner, Robert Koch, Louis Pasteur, Metchnikoff) and theories – Recent discoveries and advancements. Innate and adoptive immune response in protection. Status of immune system in invertebrates and vertebrates with reference to diversity, diversity (hematopoisis) and efficiency of cells, and molecules, anatomical organization - Functional and structural evolution of immunoglobulin.

**Unit 2 Immune response and its regulation**

Immune system in humans - Organs involved and immune response. Negative regulation - Immunological tolerance, Mechanisms of tolerance induction, T cell mediated suppression of immune response. Regulation of immune responses by: antigen, antigen-antibody complexes,

**Unit 3: Cytokines and T-cell receptors**
Types and general properties of cytokines and chemokines, characteristics of cytokine receptors and antagonists. Source and effect of Tumor necrosis factors and Interferons. Role of IL-1 in immune activation and pyrogenesis. Immunoregulatory role of cytokines (in particular IL-4, IFN-γ and TNF-β). Cytokines in therapy and disease, Super antigens and septic shock syndrome. *T-Cell Receptor*: Structure and types - αβ and γδ TCR, Diversity of TCR (gene organization and rearrangements), T cell accessory membrane molecules (CD and adhesion molecules), Role in immune activation: TCR-CD3 complex and signal transduction pathways.

**Unit 4 Tumor immunology**
Tumor immunology: Cellular transformations during neoplastic growth, Classification of tumors based on histological, physiological, biochemical and immunological properties, Tumors of lymphoid system (lymphoma, myeloma, Hodgkin’s disease). Escape mechanisms of tumor from host defense, Host immune response to tumor – Effector mechanisms, Immuno-surveillance theory. Diagnosis of tumors – biochemical and immunological tumor markers Approaches in cancer immunotherapy - Immunomodulation (definition and concept), Immune adjuvant and tumor vaccine therapy, Biological Response Modifiers (BRMs) and their application in cancer therapy and in other diseases.

**Unit 5 Immunodiagnostics and experimental immunology**
Precipitation techniques, agglutination techniques, radiology in immunotechniques, Enzyme-Linked immunosorbent assay (ELISA), Western blotting, immunofluorescence, Flowcytometry and immunoelectron microscopy. Infectious diseases - immune system in AIDS, transplantation immunology, cancer and the immune system. *In vitro* systems - kinetics of antigen antibody reactions, hemolytic plaque assay, ELISA, ELISPOT assay, functional assays for phagocytosis. *In vivo* systems – Experimental animals in immunology research (Inbred animal strains, transgenic animals), Animal models for autoimmunity and AIDS.

**References:**

PRACTICAL I: Lab work in CC-I, II, III and EC I – P13MB4P

Semester: I
Instruction Hours/Week: 6
Core Course: IV
Credit: 5

1. Media preparation- Sterilization.
2. Culture transfer techniques- Isolation of pure cultures.
3. Observation of microbial diversity from natural sources.
4. Bacterial staining (Simple- Negative- Gram’s- Capsule- Acid fast- Spore)
5. Bacterial growth curve.
6. Bacterial identification by staining, Biochemical and molecular (16s rRNA gene sequence) characteristics (based on Bergey’s manual).

Immunology

12. Separation of serum
   a. Agglutination technique
      i. ABO blood grouping and Rh typing
      ii. ASO (antistreptolycin-O) test – latex agglutination
      iii. Hemagglutination (IHA & RPHA)
b. Precipitation techniques
   i. Ouchterlony’s double immunodiffusion
   ii. Staining of immunoprecipitation slides
   iii. Single radial immunodiffusion
   iv. Counter current immunoelectrophoresis
   v. Rocket immunoelectrophoresis.

13. Immunoassays
   a. Dot ELISA (Enzyme Linked Immuno Sorbent assay)
   b. Radioimmunoassay – Basis
   c. Immunofluorescence assay – Basis


15. Animal Experiment – Basis and computer based-demonstration.

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ELECTIVE COURSE I : BIOCHEMISTRY AND ENZYMEOLOGY - P13MB5E

Semester : I
Instruction Hours/Week: 6
Credit: 4

Unit 1: Introduction to Biomolecules and their interactions
Structure of atoms, molecules and chemical bonds. Basic aspects - entropy - enthalpy -
electron carrier - artificial electron donors - inhibitors - uncouplers - energy bond -
Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic
acids and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding,
hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction
kinetics, thermodynamics, colligative properties).

Unit 2: Chemistry of proteins and nucleic acid
Structural features of amino acids, classification of amino acids, amino acids as buffers,
chemical reactions of amino acids, peptide linkage, partial double bond nature of peptides,
determination of primary structure of polypeptide (N-terminal, C-terminal determination,
method of sequencing of peptides), structural classification of proteins, primary, secondary,
tertiary, quaternary structures of proteins. Chemistry of Nucleic acid: Structure of bases,
nucleosides, nucleotides, phospho-diester linkages, 5’ phosphate, 3’hydroxyl polarity of
nucleic acids, tautomeric forms of bases and their implication in pairing of bases, structure of
DNA, Tm value, structure of t-RNA, r-RNA, and m-RNA, peptide nucleic acid (PNA).
Unit 3 Chemistry of Carbohydrate, lipid, vitamins and hormones

Carbohydrate: Mono, di oligosaccharides and polysaccharides, with examples, reducing and non-reducing sugars, sugar anomers, sugar epimers, sugar derivatives such as sugar alcohols, amino sugars, sugar acids, deoxy sugars. Lipids: Classification of lipids according to chemical structure, fatty acids, saturated, unsaturated, branched, nomenclature, system structure and function of triglycerides, phospholipids, sphingolipids, terpenes, prostaglandins, waxes, steroids. Definition and nomenclature of vitamins - biological availability - assessment of vitamins in nutritional status - vitamins B1, B12, K, E and niacin - Protein and peptide hormones - auxins, gibberellins and abscisic acid.

Unit - 4 Properties of Enzymes


Unit - 5 Enzyme kinetics

Importance of enzyme kinetics, factors affecting rates of enzyme mediated reactions (pH, temperature, substrate concentration, enzyme concentration and reaction time). Derivation of Michaelis - Menton equation and its significance in enzyme kinetic studies. Lineweaver-Burke plot, Haldane-Briggs relationship, sigmoidal kinetics steady state kinetics and transient phases of enzyme reaction.

Reference:


-VIROLOGY – P13MB6-

Semester: II  Core Course: V
Instruction Hours/Week: 6  Credit: 5

-Unit 1 Introduction to Virology-
Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultrastructure; viral genome, their types and structures; virus related agents (viroids, prions). Importance and scope of virology.

-Unit 2 General Methods of Diagnosis and Serology-
Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures; serological methods - haemagglutination; complement fixation; immunofluorescence methods, ELISA and Radioimmunoassays; assay of viruses - physical and chemical methods (protein, nucleic acid. radioactivity tracers, electron microscopy)- Infectivity assay (plaque method, end point method).

-Unit 3 Microbial Viruses-
Bacteriophage structural organization; life cycle; Details on M13, Mu, T3, T4, and Lamda P1, cyanophages, mycophages, phycophages, protozoan viruses, – their ultra structure, features and propogation.

-Unit 4 Plant Viruses-
Classification and effects of viruses on plants; Symptomatology; common virus diseases of plants: paddy, cotton, tomato, and sugarcane;; life cycle; type species of plant viruses like TMV, Cauliflower mosaic virus and Potato virus x, paddy viruses, banana viruses- banana bunch top virus (BBTV), banana streak virus (BSV), transmission of plant viruses; diagnostics in
seeds and diseased plants; prevention of crop loss due to virus infection, virus-free planting material; vector control.

**Unit 5 Animal Viruses**

Classification of animal human viruses; epidemiology, life cycle, diagnosis, prevention and treatment of RNA Viruses Picorna, Ortho myxo, Paramyxo, Hepatitis virus, Toga and other arthropod viruses, Rhabdo, Rota, HIV and other Oncogenic viruses; DNA viruses; Pox, Herpes. Adena, SV 40; Hepatitis viruses, H1N1 virus, dengue fever virus, chikungunia virus, birdflu virus. Viral vaccines (conventional vaccines, genetic recombinant vaccines, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.

**Reference:**


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**FOOD AND DAIRY MICROBIOLOGY - P13MB7**

**Semester : II**

**Instruction Hours/Week: 6**

**Core Course: VI**

**Credit: 5**

**Unit 1 Food Microbiology**

Introduction- Importance of food microbiology- Types of microorganisms in food spoilage, Source of contamination- Factors influencing microbial growth in food. Food preservations:
principles - methods of preservation - Physical and chemical methods - Radiations, UV, Gamma and microwave, temperature, Chemical and naturally occurring antimicrobials. Biosensors in food industry.

Unit - 2 Microbiology of food products
Contamination, spoilage and preservation of cereals and cereals products, sugar and sugar products, Vegetables and fruits, meat and meat products - fish and other sea foods, egg and poultry. Role of microorganisms in beverages - tea and coffee fermentations. Single cell proteins - spirulina, mushroom.

Unit - 3 Food borne diseases and quality assurance
Food borne diseases, intoxication and food poisoning - bacterial and non-bacterial food borne diseases: *Shigella*, *Staphylococcus*, *Campylobacter*, *Listeria*, *Clostridium*, *Escherichia coli* and *Salmonella* infections, Mycotoxins, Protozoan and Viral food borne diseases. Quality standards of food - Government regulatory practices and policies. FDA, EPA, HACCP and ISI. Food sanitation in food manufacture and in the retail trade.

Unit - 4 Industrial Food fermentations

Unit - 5 Dairy Microbiology

References:

GENETIC ENGINEERING – P13MB8

Semester : II  
Instruction Hours/Week: 6  
Core Course: VII  
Credit: 5

Unit 1 Introduction to molecular biology

Introduction to molecular biology and genetics: - Historical background, nature of genetic material, experimental proof that DNA is the genetic material, different forms of DNA (A, B and Z DNA) properties of DNA, DNA denaturation and renaturation, central dogma, Special types of DNA, satellite DNA and tandem repeats.

Unit 2 DNA and RNA Metabolism

DNA replication: Mechanism of prokaryotic DNA replication, semiconservative model of replication, mechanisms of DNA replication, Discontinuous synthesis of DNA, RNA primer for DNA synthesis, DNA polymerases I, II and III and role of ligases and these mechanism of action and role in DNA replication. Replication of viral DNA rolling circle model; DNA repair; DNA recombination. DNA dependent synthesis of RNA: RNA polymerase in prokaryotes, its molecular composition, role of each component of RNA polymerase, mechanism of transcription, eukaryotic transcription and eukaryotic RNA polymerases.; RNA dependent synthesis of RNA and DNA. Splicing of mRNA: Modification in RNA: 5’ CAP formation, 3’ end processing, polyadenylation, splicing, editing, nuclear export of mRNA and mRNA stability. Processing of other RNA’s, Ribosome formation.
**Unit 3 Protein Metabolism, Gene Regulation and Silencing**


**Unit - 4 Recombinant DNA technology**


**Unit- 5 Specialized cloning strategies, application of PCR and genome mapping**

Genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Genetically engineered micro organisms (GEMS) / genetically modified organisms (GMO's). DNA sequencing methods, Sequence assembly. Automated sequencing. Genetic and physical maps, physical mapping and map - based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome microdissection and microcloning, molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree, varietal, animal trafficking and poaching: taxonomy, biodiversity and DNA barcoding.
Reference:

Genome by T.A. Brown. Publisher: John Willey & Sons Inc.

Publisher: Oxford University Press

Molecular Cell Biology Publisher: W.H. Freeman and Company.

Publisher: Cold spring Harbor Laboratory Press.

Publisher: Addison- Wesley Publishing.

ASM Publications.


Amplification. Stockton Press.

Publications.


PRACTICAL COURSE FOR CC V, VI, VII and EC II – P13MB9P

Semester: II Core Course: VIII

Instruction Hours/Week: 6 Credit: 5

Virology:

1. Isolation and characterization of bacteriophage from natural sources.

2. Preparation of bacteriophage stock – basis and demonstration.

3. Phage Titration - T4 and M13 - Basis

4. Burst size determination - A one step growth curve of bacteriophage T4 - Basis
5. Determination of lysogeny by using Lambda phage - Basis
6. Study of virus infected plant samples
7. Thermal characterization, Longevity *in vitro* - Dilution end point - Basis
9. Field visit.
10. Demonstration of koch’s postulates.

**Genetic engineering**

10. Total soluble protein isolation, Polyacrylamide Gel Electrophoresis.
11. Isolation of genomic DNA (bacterial).
12. Visualization of isolated genomic DNA by agarose gel electrophoresis.
13. Isolation of plasmid DNA & restriction digestion
15. Amplification of DNA by PCR & RAPD.

**Food and Dairy Microbiology**

17. Sauerkraut fermentation - Basis.
18. Isolation of food poisoning bacteria from contaminated foods, Dairy products.
19. Extraction and detection of afla toxin for infected foods - Basis.
21. Production of fermented milk by *Lactobacillus* sp.
22. Field visit.

**Mycology, phycology, Lichenology and Protozoology**

23. Isolation and growth of fungi.
24. Staining and microscopic examination of fungi
25. Isolation and microscopic identification of algae, lichen and protozoa from natural sources.

ELECTIVE COURSE II: PHYCOLOGY MYCOLOGY, LICHENOLOGY AND PROTOZOOLOGY – P13MB10E

Semester : II
Instruction Hours/Week: 6
Credit: 4

**Unit 1 Phycology**

products from algae – algae as food – algal diseases - Life Cycles of *Chlamydomonas, Oscillatoria, Volvox, Spirogyra, Laminaria, and Batrachospermum*.

**Unit 2 Introduction to mycology**

Historical introduction to mycology structure and cell differentiation, Classification of fungi, Evolutionary tendencies in lower fungi. Saprophytic fungi, fungal genetics, resistance and virulence. A brief account of fungal cell structure, nutrition, reproduction and representative life cycles of some fungi - *Synchytrium, Perenospora, Albugo, Rhizopus, Aspergillus, Penicillium, Ustilago* and *Puccinia*; Fungi in plant diseases and its economic importance - fungi and nematodes - fungi as parasites of insects.

**Unit 3 Fungal reproduction, ecology and diseases**

Heterothalism, sexual behavior in fungi, Physiological specialization, phylogeny of fungi - Fungi as insect symbiont. Mycorrhiza - Plants as an environment for fungal growth. Fungus plant conformation. Effects of pathogenic fungal infusion on host plant physiology - Physiology and structure of symbiotic fungi, host-symbiont interactions, their effects on host growth and their agricultural applications. Fungal diseases - Mycoses (systemic and subcutaneous), Candidiasis, Pneumocystis, blastomycoses, dermatomycoses and other diseases.

**Unit 4 Lichenology:** Morphology, diversity, reproduction, symbiotic nature, chemical interactions and traditional & commercial uses.

**Unit 5 Protozoology**


**Reference:**


 PHARMACEUTICAL MICROBIOLOGY – P13MB11

Semester : III  Core Course: IX
Instruction Hours/Week: 6 Credit: 5

Unit 1: Introduction

Historical perspective – Paul Ehrlich’s postulates, Case studies of development of drug such as sulphur drugs, arsenicals. Current approaches to drug discovery: Rational Drug design, receptor / target concept in drug designing, bioinformatics tools in drug designing - molecular docking.

Unit 2 Advances in Drug discovery

Unit 3: Preclinical development of drug discovery


Unit 4. Clinical development of biologicals


Unit 5. Mechanisms of virulence

A step wise process of infection – Crossing physical, chemical and biological barriers, Colonization, association, adhesion and Invasion of host tissue and toxigenesis. with details account of virulence factors – Adhesins (pili, capsule, hemagglutinins), Invasins (Fibrinolysins, hyaluronidase, hemolysins, hypal extensions), Evasins (catalase, coagulase, Siderophores, Leucocidins, Kinins), Biofilm formation. Toxins (diphtheria, cholera, tetanus toxins and endotoxins of Gram negative bacteria – mode of action and in vivo and in vitro assay systems). Mechanisms of bacterial resistance to host cellular (phagocytosis) and humoral defenses. Molecular basis of bacterial pathogenecity – cytoskeletal modulation of host cell, virulence genes and pathogenecity islands.

References:
14. Lorian.V., (1986), Antibiotics in laboratory medicine, 2nd Ed, Williams & Wilkins Publication

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ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY - P13MB12
Semester : III Core Course: X
Instruction Hours/Week: 6 Credit: 5

Unit1 Aerobiology and aquatic microbiology

Unit 2 Soil Microbiology and Ecological Role of Microbes
Classification of soils - physical and chemical characteristics, microflora of various soil types (bacteria and nematodes in relevance to soil types) - Biogeochemical cycles and the organisms, - carbon nitrogen - phosphorus and sulphur, Major bacteria and fungi of soil. Biodegradation of recalcitrant compounds - lignin - pesticides; bioaccumulation of metals and detoxification - biopesticides; biodeterioration of paper - leather, wood, textiles - metal corrosion - mode of deterioration organisms involved - its disadvantages - mode of prevention. GMO and their impact.

Unit 3 Waste treatment and microbial processes

Unit-4 Plant microbe interaction and its Role in Agriculture
Types of interaction (Symbiosis, parasitism, mutualism, commensalisms, saprophytism, necrotrophism etc), Plant and microbial surface organization, concept of rhizosphere, non rhizosphere, mycorhizosphere - ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza - application- rhizoplane and phyllosphere. Microbial plant diseases: disease development, plant defense mechanisms DIMBO ad DIMBOA, cultivar dependent and independent resistance, disease forecasting, disease control (disease escaping), cultural, chemical and biocontrol.

Unit-5 Concepts of sustainable agriculture.

Reference:
12. KG Mukerji, C. Manoharachary & J. Singh (2006). Microbial Activity in the Rhizosphere (Soil Biology Series), Published by Springer-Verlag, Germany, Editors:

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PRACTICAL – III (Lab work in CC-IX, X & EC-III) - P13MB13P
Semester : III Core Course: XI
Instruction Hours/Week: 6 Credit: 5

Pharmaceutical Microbiology

1. Collection and transport of clinical specimens for microbiological examinations.
2. Screening of antimicrobial agents from natural sources against given bacteria.
4. Treatment of bacterial cells with cetrimide, phenol and detection of Leaky substances such as potassium ions, aminoacids, due to cytoplasmic membrane damage – demonstration and basis.
5. To determine MIC, LD 50 of Beta-lactum/aminoglycoside/ tetracycline/ansamycins.
6. Sterility testing.
7. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations).

**Environmental and Agricultural Microbiology**
11. MPN index – presumptive, completed and confirmative tests.
12. Isolation of microflora from different industrial wastes.
15. Localization of AMF.

**Microbial Biotechnology**
16. Isolation of industrially important microorganisms for microbial processes (e.g. α - alpha amylase) and improvement of strain.
17. Preparation of enzyme immobilized columns for biotransformation – e.g. yeast cells immobilized in calcium alginate beads.
18. Analysis of enzyme activity from immobilized cells:
   a. Comparative enzyme activity of free cells and immobilized cells
   b. Effect of gel concentration on enzyme activity
19. Extraction of Citric acid/Lactic acid by salt precipitation.
20. Comparison of ethanol production using various Organic wastes / raw Material [Free cells/ immobilized cells].

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ELECTIVE COURSE – III : MICROBIAL BIOTECHNOLOGY – P13MB14E

Semester - III
Instruction hrs /week: 6 hrs.
Credit : 4
Elective course: III

Unit 1 Introduction to Industrial microbiology
Principles of exploitation of micro-organisms and their products, screening, strain development strategies, immobilisation methods, adsorption; covalent linkages – advantages
and disadvantages, raw materials used in media production, industrial sterilization, fermentation equipment and its uses, types of fermentation—single, batch, continuous, dual or multiple, surface, submerged and solid state fermentation. Biology of industrial microorganisms such as Streptomyces, yeasts, *Spirulina* and *Penicillium* – Strain improvement – Culture preservation - Stock culture collection centres – Criteria used for the selection of microorganisms for fermentation.

**Unit 2 Bioreactor design and operation:**

**Unit 3 Product based industrial Processes**

**Unit 4 Bioenergy from microbes**
Bioethanol (microbial production), biobutanol, biogas and biodiesel (microalgae and other microbes) production from microbes – Microbial fuel cell – concept, scope and recent developments – hydrogen photoproduction.

**Unit 5 Principles of Validation Process / Method and commercialization**
**References:**

**ELECTIVE COURSE – IV : PLANT DIVERSITY – P13MB15E**

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<th>Semester</th>
<th>III</th>
<th>Elective Course: IV</th>
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<td>Instruction Hours/Week:</td>
<td>6</td>
<td>Credit: 4</td>
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**Unit 1 Bryophytes**
General characteristics, classification by Watson, Range of vegetative structure, Evolution of gametophytes and sporophytes – Ecological and economic importance of Bryophytes.

**Unit 2 Pteridophytes**
General characteristics, classification by Reimer, Range of morphology, reproduction and evolution of gametophytes and sporophytes – Heterospory and origin of seed habit.

**Module 3 Gymnosperm diversity**
General characteristics, classification by Sporne: morphology, anatomy, reproduction and Economic importance.

**Unit – 4 Angiosperm diversity**
Unit 5 Economic botany


Reference:

BIOINFORMATICS AND BIOSTATISTICS – P13MB16

Semester : IV
Instruction Hours/Week: 6
Core Course: XII
Credit: 5

UNIT – 1 Introduction and Nucleic acid databases

Organization, Data Retrieval, Submission, Mining. Sequence alignment: FASTA, BLAST – algorithm & tools. cDNA libraries and ESTs. EST analysis tools- sequence similarity search tools, sequence assembly tools and sequence clustering tools. *In silico* Gene identification – Strategies and tools.

**UNIT – 2 Protein databases**
Protein databases - Primary databases - SWISS-PROT, PIR, MIPS, TrEMBL, NRL-3D, Composite databases- PROSITE, PROFILES, PRINTS, Pfam, BLOCKS, IDENTIFY - Organization, Data Retrieval, Submission, Mining. Protein structural databases: PDB, MMDB – Visualization, Classification (SCOP & CATH). Secondary & Tertiary structure prediction- Methods (Sequence based & *AB INITIO*) & tools.

**UNIT – 3 Alignment and Phylogeny**

**Unit 4 Biostatistics**

**Unit – 5 Measures of Relation and Tests of significance**
Measures of Relation: Correlation, Regression and Principle component analyses. Tests of significance: Small sample test (Chi-square t test, F test), large sample test (Z test), ANOVA and standard error. Introduction to probability theory and distributions, binomial, exponential, Gaussian and Poisson distribution and normal (only definitions and problems). Computer oriented statistical techniques (Microsoft Excel and SPSS) - Frequency table of single discrete variable, bubble spot, computation of mean, variance and standard Deviations, t test, correlation coefficient.
References:

RESEARCH TECHNIQUES AND SCIENTIFIC COMMUNICATION – P13MB17

Semester : IV Core Course: XIII
Instruction Hours/Week: 6 Credit: 5

Unit 1 Research Concepts and Data Collection
Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; Hypotheses Research Purposes - Research Design - Survey Research - Case Study Research. Sources of Data: Primary Data, Secondary Data; Procedure Questionnaire - Sampling Merits and Demerits - Experiments - Kinds - Procedure; Control Observation - Merits - Demerits - Kinds - Procedure - Sampling Errors - Type-I Error - Type-II Error.

Unit 2 Writing Research proposal
Developing an outline Preamble, the problem, specific aims, background and significance, hypothesis to be tested, study design, setup, measurement procedures, analysis of data, displaying preliminary data in tables, graphs and charts. Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.
Unit 3. Scientific communications
Title and abstract for a given text - Choosing and indexing key words from a given paper-
Writing the paper based on a given set of instructions to authors. (Any refereed journal may
be used for sample ‘Instructions to Authors’) - Writing a newspaper report / popular article of
a latest research paper - Writing a pedagogical (academic) article on a scientific theme -
Critically comment on a manuscript. Drawing appropriate figures on given data, writing
footnotes to figures and tables - Preparation of display material (such as scientific posters).
Photomicrography, taking photographs of experimental results. Scanning pictures, Making
Power Point slide shows.

Unit 4: Bioinstrumentation
Basic laboratory Instruments - Principle and working of pH meter, Laminar-air flow.
Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges,
differential centrifugation, sedimentation velocity, sedimentation equilibrium, density
gradient methods and their applications.

Unit – 5 Chromatographic, Electrophoretic and radio isotopic techniques
Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity,
hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC) Basic
principles of electrophoresis, theory and application of paper, starch gel, agarose, native and
denaturing PAGE, isoelectric focusing. Spectroscopic techniques - theory and applications of
Radioisotopic techniques Use of radioisotopes in life sciences, radioactive labeling, principle
and application of tracer techniques, detection and measurement of radioactivity using
ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters,
autoradiography and its applications. Dosimetry.

Reference:
Publishers & Distributors Pvt. Ltd (O’Reilly), Mumbai

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**ELECTIVE COURSE V: IPR, BIOSAFETY AND BIOETHICS - P13MB18E**

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<td>Elective Course: V</td>
<td>Credit: 4</td>
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**Unit 1 Biosafety - Introduction**


**Unit 2 Biosafety Guidelines**

Guidelines and regulations (National and International including Cartegana Protocol) – operation of biosafety guidelines and regulations of Government of India; Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture. Environmental release of GMOs - Risk - Analysis, Assessment, management and communication.

**Unit 3 Bioethics**

Unit 4 Intellectual Property Rights

Unit 5 Patents and Patent Laws

References:

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PROJECT WORK - P13MBP19

Semester : IV
Instruction Hours/Week: 12

PROJECT WORK
(Dissertation 75 marks & Viva Voice – 25 Marks)

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