### 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>
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<td>I</td>
<td>CC I</td>
<td>General Microbiology</td>
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<td>CC III</td>
<td>Immunology</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>EC I</td>
<td>Biochemistry and Enzymology</td>
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<td>II</td>
<td>CC V</td>
<td>Virology</td>
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<td>CC VI</td>
<td>Food and Dairy Microbiology</td>
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<td>CC VII</td>
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<td>CC VIII P</td>
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<td>EC II</td>
<td>Phycology, Mycology, Lichenology and Protozoology</td>
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<td>CC XIII</td>
<td>Research Techniques and Scientific Writing</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.
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:
7.

BACTERIOLOGY – P13MB2
Semester: I
Core Course: II
Instruction Hours/Week: 6
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 cholerea and Treponema pallidum) and bacterial zoonotic diseases (Anthrax, Brucellosis, Psittacosis and Tularemia).
Reference:

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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
Core Course: IV
Instruction Hours/Week: 6
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 immno precipitation slides
   iii. Single radial immunodiffusion
   iv. Counter current immuno electrophoresis
   v. Rocket immunoelectrophoresis.

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


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

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ELECTIVE COURSE I : BIOCHEMISTRY AND ENZYMOLOGY - 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, phosho-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:

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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, Orthomyxo, 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:

FOOD AND DAIRY MICROBIOLOGY - P13MB7
Semester : II Core Course: VI
Instruction Hours/Week: 6 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 preservations-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:**


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GENETIC ENGINEERING – P13MB8

Semester : II Core Course: VII
Instruction Hours/Week: 6 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 mRMA: 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

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.


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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.

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

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

Unit 1 Phycology
Introduction – algae as primary producers – Characteristics: morphology, algal pigments and motility - Distribution of algae, classification of algae by Fitsch, algal nutrition, algal thallus, algal reproduction, green algae, diatoms, euglenoids, Rhodophyta, Pyrrophyta, Algal ecology and algal biotechnology, Marine algae, sea weeds and their applications - Commercial

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, Perenopora, 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:


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PHARMACEUTICAL MICROBIOLOGY – P13MB11

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

Unit 1: Introduction

Historical perspective – Paul Ehrlich’s postulates, Case studies of development of drug such as sulpha 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

Regulatory authorities for introduction of medicines in market - Role of Food and Drug Administration, FDA guidelines for drugs / biologicals, Validation (GMP, GLP, GCP, etc.). Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials – Objectives, Conduct of trials, Outcome of trials. Delivery systems - formulations, targeted drug delivery, Sustained release of drugs. Drug distribution in body, bio-availability and pharmacokinetic studies.

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

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, necrotrophic 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 independant independent resistance, disease forecasting, disease control (disease escaping), cultural, chemical and biocontrol.

**Unit-5 Concepts of sustainable agriculture.**

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

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

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:

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ELECTIVE COURSE – IV : PLANT DIVERSITY – P13MB15E
Semester : III
Instruction Hours/Week: 6
Elective Course: IV
Credit: 4

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:
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

Reference:

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ELECTIVE COURSE V : IPR, BIOSAFETY AND BIOETHICS – P13MB18E

Semester : IV  Elective Course: V
Instruction Hours/Week: 6  Credit: 4

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  Project
Instruction Hours/Week: 12  Credit: 5

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

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The National College is an institution for higher education at Tiruchirapalli, Tamil Nadu, India.[1] Established in 1919, the college provides education to economically and socially deprived students. During the Indian independence movement, the college was a breeding ground for nationalist sentiment. Academic programs include Tamil and English Literature, Geology, Mathematics, Physics, Chemistry, Commerce, Management, Economics, Philosophy, Botany, Zoology and History. Prominent visitors to the college include Mahatma Gandhi,[2] Pandit Jawaharlal Nehru, Rajaji, C. N. Annadurai, as well as alu National College Tiruchirapalliâ€”(NCT), was established in June 1919, re-accredited by National Assessment and Accreditation Council (NAAC) with a grade of â€œA++â€. It is a private college affiliated to Bharathidasan University, Palkalaiperur Campus, offering both undergraduate and postgraduate courses. About 53 courses across 5 streams, with 11 specializations are offered by the college. Like other colleges, National College also has a Training and Placement cell where the students are groomed through programs that offer various services to meet the professional development needs of students. The final year students are provided the following pieces of training: Basic Communication Skills Training. National College, Tiruchirappalli, Tiruchirappalli. 228 likes · 7 talking about this · 7,089 were here. The National College is an institution for...Mohamed Jaabir is with Raghunathan Kalamegam and Prasanna Balaji at National College, Tiruchirappalli. 13 April at 08:50 · Tiruchirappalli, India. The general belief of the public right now is this 1. People think that PCR or COVID-19 Diagnosis is some Rocket Science and that we don't have such sophisticated facilities in the state in good numbers to enable quick diagnosis.