Syllabus
MICROBIOLOGY
(UG courses)
Admitted Batch 2008 -2009

May 2008
A.P. State Council of Higher Education
SUBJECT COMMITTEE

1. Prof.Gopal Reddy, Osmania University, Hyderabad
2. Prof.G.Subbarangaiah, Andhra University, Visakhapatnam
3. Prof.P.Sreenivasulu, S.V.University, Tirupati
4. Prof.S.Ram Reddy, Kakatiya University, Warangal
5. Prof.M.Vijayalakshmi, Acharya Nagarjuna University, Guntur
6. Prof.PBBN Charyulu, S.K. University, Anantapur
7. Mr.K.Vijayakumar, Jawahar Bharathi, Kavali
8. Dr.V.V.Ramana, Singareni Degree College, Kothagudem
9. Dr.G.Ramakrishna, Govt. Arts College, Anantapur
10. Mr.G.Sai Ramalinga Reddy, SSBN College, Anantapur
11. Prof.K.Venkateswarlu, S.K.University, Anantapur       Coordinator
## CURRICULUM

### B.Sc. Courses (Structure)

#### First year:

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Subject</th>
<th>Hrs per week</th>
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<tr>
<td>1.</td>
<td>English language including communication skills</td>
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#### Second year:

<table>
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<th>Subject</th>
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<td>English language including communication skills</td>
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<tr>
<td>2.</td>
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<td>9.</td>
<td>Environmental studies</td>
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#### Third year:

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<th>Subject</th>
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## MICROBIOLOGY

<table>
<thead>
<tr>
<th>Year</th>
<th>Paper No.</th>
<th>Theory/Lab</th>
<th>Title</th>
<th>Workload Hrs/Week</th>
<th>Exam Duration Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>I Theory</td>
<td>Introductory Microbiology</td>
<td>4 Hrs</td>
<td>3 Hrs</td>
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<tr>
<td>I</td>
<td>I Lab</td>
<td>Introductory Microbiology</td>
<td>3 Hrs</td>
<td>3 Hrs</td>
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<tr>
<td>II</td>
<td>II Theory</td>
<td>Microbial physiology and Genetics</td>
<td>4 Hrs</td>
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<td>II</td>
<td>II Lab</td>
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<td>III</td>
<td>III Theory</td>
<td>Immunology and Medical Microbiology</td>
<td>3 Hrs</td>
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<td>III</td>
<td>III Lab</td>
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<td>3 Hrs</td>
<td>3 Hrs</td>
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<td>IV</td>
<td>IV Theory</td>
<td>Applied Microbiology</td>
<td>3 Hrs</td>
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<td>IV Lab</td>
<td>Applied Microbiology</td>
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**Total number of hours for theory papers and labs in an academic year:**

- **Theory Paper I:** 120 Hrs  
  **Lab I:** 90 Hrs (30 sessions)
- **Theory Paper II:** 120 Hrs  
  **Lab II:** 90 Hrs (30 sessions)
- **Theory Paper III:** 90 Hrs  
  **Lab III:** 90 Hrs (30 sessions)
- **Theory Paper IV:** 90 Hrs  
  **Lab IV:** 90 Hrs (30 sessions)
Paper I: INTRODUCTORY MICROBIOLOGY

UNIT – I  History of Microbiology and Microscopy 30Hrs
Meaning, definition and history of Microbiology.
Importance and applications of Microbiology.
Principles of microscopy – bright field, dark field, phase-contrast, fluorescent and electron microscopy (SEM and TEM). Ocular and stage micrometers. Size determination of microorganisms.
Principles and types of stains - Simple stain, differential stain, negative stain, structural stains - spore, capsule, flagella. Hanging-drop method.

UNIT – II  Microbiological Techniques 30 Hrs
Sterilization and disinfection techniques
Principles and methods of sterilization.
Physical methods - autoclave, hot-air oven, pressure cooker, laminar air flow, filter sterilization.
Radiation methods - UV rays, gamma rays, ultrasonic methods.
Chemical methods - Use of alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites. Phenol coefficient.
Isolation of pure culture techniques - Enrichment culturing, dilution-plating, streak-plate, spread-plate and micromanipulator.
Preservation of microbial cultures - subculturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.

UNIT – III  Biology of Prokaryotic and Eukaryotic Microorganisms 30 Hrs
Outline classification of living organisms: Heckel, Whittaker and Carl Woese systems.
Place of microorganisms in the living world.
Differentiation of prokaryotes and eukaryotes.
Prokaryotes - General characteristics of bacteria, archaebacteria, rickettsias, mycoplasmas, cyanobacteria and actinomycetes.
Outline classification for bacteria as per the second edition of Bergey’s Manual of Systematic Bacteriology (up to order level).

Ultrastructure of a bacterial cell: Invariant components - cell wall, cell membrane, ribosomes, nucleoid. Variant components - Capsule, flagella, fimbriae, endospore and storage granules.

General characteristics and classification of viruses. Morphology and structure of TMV and HIV.

Structure and multiplication of lambda bacteriophage.

Eukaryotes - General characteristics and classification (up to the order level) of eukaryotic microorganisms - Protozoa, microalgae, molds and yeasts.

UNIT – IV    Biomolecules    30 Hrs

Biomolecules of microorganisms.

Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides).

General characteristics of amino acids and proteins.

Structure of nitrogenous bases, nucleotides, nucleic acids.

Fatty acids (saturated and unsaturated) and lipids (spingolipids, sterols and phospholipids).

Hydrogen ion concentration in biological fluids, pH measurement.

Types of buffers and their use in biological reactions.

Principle and application of colorimetry and chromatography (paper and thin-layer).

TEXT AND REFERENCE BOOKS:


INTRODUCTORY MICROBIOLOGY

1. Precautions to work in Microbiology laboratory.
2. Preparation of culture media: Solid / Liquid.
4. Isolation of single colonies on solid media.
5. Enumeration of bacterial numbers by serial dilution and plating.
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram –ve bacilli), cyanobacteria (Nostoc, Spirulina), algae (Scenedesmus sp., diatoms), and fungi (Saccharomyces, Rhizopus, Aspergillus, Penicillium, Fusarium).
8. Calibrations of microscopic measurements (Ocular, stage micrometers).
9. Measuring dimensions of fungal spores
10. Simple and differential staining (Gram staining).
11. Spore staining, capsule staining and negative staining.
12. Diagramatic or Electron photomicrographic observation of TMV, HIV, T4 phage and adenovirus

REFERENCE BOOKS FOR LAB:


ANDHRA UNIVERSITY

II Year B.Sc. MICROBIOLOGY SYLLABUS 2009-10

Microbiology 8 of 40
Paper II: MICROBIAL PHYSIOLOGY AND GENETICS

UNIT – I Nutrition, Growth and Enzymes 30 Hrs
Microbial nutrition - nutritional requirements and uptake of nutrients by cells. Nutritional groups of microorganisms - autotrophs, heterotrophs, mixotrophs, methylotrophs.

Growth media - synthetic, nonsynthetic, selective, enrichment and differential media. Microbial growth - different phases of growth in batch cultures.

Factors influencing microbial growth.

Synchronous, continuous, biphasic growth.


Enzymes - properties and classification, enzyme unit.

Biocatalysis - induced fit, and lock and key model, coenzymes, cofactors, factors affecting catalytic activity of enzymes.

Inhibition of enzyme activity - competitive, noncompetitive, uncompetitive and allosteric.

UNIT – II Intermediary Metabolism 30 Hrs


Glyoxylate cycle. Anaerobic respiration (nitrate, sulphate respiration).

Fermentation - Common microbial fermentations with special reference to alcohol and lactic acid fermentations.

Photosynthetic apparatus in prokaryotes. Outlines of oxygenic and anoxygenic photosynthesis in bacteria.

UNIT – III Microbial Genetics 30 Hrs

Fundamentals of genetics - Mendelian laws, alleles, crossing over, and linkage. DNA and RNA as genetic materials.

Structure of DNA – Watson and Crick model.

Extrachromosomal genetic elements – Plasmids and transposons.

Replication of DNA – Semiconservative mechanism.

Outlines of DNA damage and repair mechanisms.

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.

Various physical and chemical mutagens.
Brief account on horizontal gene transfer among bacteria – transformation, transduction and conjugation.

UNIT – IV Gene Expression and Recombinant DNA Technology  30 Hrs

Concept of gene – Muton, recon and cistron. One gene-one enzyme, one gene-one polypeptide, one gene-one product hypotheses.
Types of RNA and their functions.
Outlines of RNA biosynthesis in prokaryotes.
Genetic code. Structure of ribosomes and a brief account of protein synthesis.
Types of genes – structural, constitutive, regulatory.
Operon concept. Regulation of gene expression in bacteria – lac operon.
Basic principles of genetic engineering - restriction endonucleases, DNA polymerases and ligases, vectors.
Outlines of gene cloning methods.
Genomic and cDNA libraries.
General account on application of genetic engineering in industry, agriculture and medicine.

TEXT AND REFERENCE BOOKS:


1. Preparation of media for culturing autotrophic and heterotrophic microorganisms - Algal medium, mineral salts medium, nutrient agar medium, McConkey agar, and blood agar.
2. Enrichment culturing and isolation of phototrophs and chemoautotrophs.
3. Setting and observation of Winogradsky column.
5. Turbidometric measurement of bacterial growth.
6. Bacterial growth curve.
8. Qualitative analysis of sugars and amino acids.
10. Colorimetric estimation of proteins by Biuret/Lowry method
11. Paper chromatographic separation of sugars and amino acids
12. Starch hydrolysis, catalase test and sugar fermentation test.
13. Qualitative tests for sugars and amino acids.
14. Qualitative test and estimation of glucose.
15. Verification of Beer’s law.
16. Problems related to DNA and RNA characteristics, Transcription and Translation.

REFERENCE BOOKS FOR LAB:

ANDHRA UNIVERSITY

III Year   B.Sc. MICROBIOLOGY SYLLABUS 2010-11

Paper III: IMMUNOLOGY AND MEDICAL MICROBIOLOGY  90 hrs
(3 hrs/ week)

UNIT – I  History of Immunology and Immune System  22 Hrs

Development of immunology.

Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity.

Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes.

Cells of immune system.

Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils.

UNIT – II  Basics of Immunology  22 Hrs

Antigens – types, chemical nature, antigenic determinants, haptens.

Factors affecting antigenicity. Antibodies – basic structure, types, properties and functions of immunoglobulins.

Components of complement and activation of complement.

Types of antigen-antibody reactions – agglutination, blood groups, precipitation, neutralization, complement fixation.

Labeled antibody based techniques – ELISA, RIA and Immunofluorescence. Polyclonal and monoclonal antibodies – production and applications.

Types of hypersensitivity – immediate and delayed.

Autoimmunity and its significance.

UNIT – III  Clinical Microbiology  23 Hrs

History of medical microbiology.

Normal flora of human body.

Definition of infection, non-specific defense mechanisms, mechanical barriers, antagonism of indigenous flora.

Anti-bacterial substances – lysozyme, complement, properdin, antiviral substances, phagocytosis.

General principles of diagnostic microbiology.

Collection, transport and processing of clinical samples.

General methods of laboratory diagnosis – cultural, biochemical, serological and molecular methods.

Tests for antimicrobial susceptibility.
Antiviral agents – interferon and base analogues.
Host-pathogen interactions. Bacterial toxins, virulence and attenuation.

UNIT – IV  Microorganisms and Diseases  23 Hrs
Elements of chemotherapy – therapeutic drugs. Drug resistance.
Mode of action of penicillin and sulpha drugs, and their clinical use.
Preventive control of diseases – active and passive immunization.  Vaccines –
natural and recombinant.

General account of the following diseases – causal organisms, pathogenesis, epidemiology, diagnosis, prevention and control of:

- Air-borne diseases
  - Tuberculosis, Influenza

- Food and water-borne diseases
  - Cholera, Typhoid, Hepatitis- A
  - Poliomyelitis, Amoebiasis

- Insect-borne diseases
  - Malaria, Filariasis, Dengue fever

- Contact diseases
  - Syphilis, Gonorrhoea

- Zoonotic diseases
  - Rabies, Anthrax

- Blood-borne diseases
  - Serum hepatitis, AIDS

General account of nosocomial infections.

TEXT AND REFERENCE BOOKS:


PRACTICAL PAPER - III

IMMUNOLOGY AND MEDICAL MICROBIOLOGY

1. Blood tests – TC, DC and ESR.
2. Estimation of blood haemoglobin.
3. Determination of blood groups and Rh typing.
5. Acid-fast staining of mycobacteria (stained/permanent slides).
6. Isolation and identification of medically important bacteria (E. coli, Klebsiella, Pseudomonas, Staphylococcus and Streptococcus) by cultural, microscopic and biochemical tests.
8. Parasites – Malarial parasite, Entamoeba (study of permanent slides).
9. Observation of fungal pathogen (Candida).
10. Tests for disinfectant (Phenol coefficient).

REFERENCE BOOKS FOR LAB:


UNIT - I  Agricultural Microbiology  23 Hrs

Physical and chemical characteristics of soil.
Rhizosphere and phyllosphere.
Biofertilizers - *Rhizobium*.

Concept of disease in plants.
Symptoms of plant diseases caused by fungi, bacteria, and viruses.
Plant diseases caused by fungi (groundnut rust), bacteria (angular leaf spot of cotton) and viruses (tomato leaf curl).

Principles of plant disease control.
Biological control of plant diseases. Biopesticides – *Bacillus thuringiensis*, Nuclear polyhedrosis virus (NPV), *Trichoderma*.

UNIT – II  Environmental Microbiology  22 Hrs

Microorganisms of environment (soil, water and air).
Role of microorganisms in nutrient cycling (carbon, nitrogen, sulphur).
Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

Microbiology of potable and polluted waters. *E. coli* and *Streptococcus faecalis* as indicators of water pollution. Sanitation of potable water.

Sewage treatment (primary, secondary and tertiary).


Microbiology of air and air sampling methods.

UNIT – III  Food Microbiology  23 Hrs

Microorganisms of food spoilage and their sources.

Spoilage of different food materials - fruits, vegetables, meat, fish.
Canned foods. Food intoxication (botulism and staph poisioning), food-borne diseases (salmonellosis and shigellosis) and their detection.

General account of food preservation.

Microbiological production of fermented foods – bread, cheese, yogurt.
Biochemical activities of microbes in milk.

Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw)

Concept of probiotics.

**UNIT – IV  Industrial Microbiology  22 Hrs**

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes.

Screening and isolation of industrially-important microorganisms.

Outlines of strain improvement.

Types of fermentation – aerobic, anaerobic, batch, continuous, submerged, surface, solid state.

Design of a stirred tank reactor fermentor. Fermentation media.

Industrial production of alcohols (ethyl alcohol), beverages (beer), enzymes (amylases), antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid), vitamins (B12), biofuels (biogas - methane)

**TEXT AND REFERENCE BOOKS:**


1. Isolation and enumeration of major groups of microorganisms from rhizosphere and nonrhizosphere.
2. Study of root nodules and isolation of *Rhizobium* from legume root nodules.
3. Isolation of *Azospirillum* / *Azotobacter*.
4. Staining and observation of vesicular-arbuscular mycorrhizal (VAM) fungi.
5. Observation of plant diseases of local importance – Rusts, smuts, powdery mildews, tikka disease of groundnut, citrus canker, bhendi yellow vein mosaic, tomato leaf curl, little leaf of brinjal.
6. Isolation of antagonistic microorganisms by crowded plate technique.
7. Isolation of microorganisms of air by Petri plate exposure method.
8. Determination of biological oxygen demand (BOD) of polluted water.
9. Microbial testing of water by coliform test (multiple tube fermentation method).
10. Determination of microbiological quality of milk – MBRT.
11. Observation of different spoiled foods.
12. Isolation of fungi and bacteria from spoiled fruits and vegetables.
13. Alcohol production and estimation; Calculation of fermentation efficiency.
15. Citric acid production and estimation.
16. Estimation of ascorbic acid from fruit juices.

**REFERENCE BOOKS FOR LAB:**


B.Sc. Core (Optional) Subject: MICROBIOLOGY

Model Question Papers (Theory and Lab)
B.Sc. Core (Optional) Subject: MICROBIOLOGY

Model Question Paper (Theory)

Part – A

(TWO questions are to be set from each unit)
Answer ALL questions
Each question carries 5 marks  8 x 5 = 40 Marks

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 

Part – B

(TWO questions are to be set from each unit)
Answer any FOUR questions
Each question carries 15 marks  4 x 15 = 60 Marks

9. a) or  
   b) 
   } to be set from Unit I

10. a) or  
       b) 
   } to be set from Unit II

11. a) or  
      b) 
   } to be set from Unit III

12. a) or  
       b) 
   } to be set from Unit IV
MODEL CURRICULUM

B.Sc. Core (Optional) Subject: MICROBIOLOGY

ALLOCATION OF HOURS TO EACH UNIT AND EACH SUBUNIT
## B.Sc. Core (Optional) Subject: MICROBIOLOGY

### COURSE PATTERN AND SCHEME OF INSTRUCTIONS AND EXAMINATION

(Medium of Instruction and Examination shall be only in English)

<table>
<thead>
<tr>
<th>Year</th>
<th>Paper No.</th>
<th>Theory/Lab</th>
<th>Title</th>
<th>Workload Hrs/Week</th>
<th>Exam Duration Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>I Theory</td>
<td></td>
<td>Introductory Microbiology</td>
<td>4 Hrs</td>
<td>3 Hrs</td>
<td>100</td>
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<tr>
<td>I Lab</td>
<td></td>
<td></td>
<td>Introductory Microbiology</td>
<td>3 Hrs</td>
<td>3 Hrs</td>
<td>50</td>
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<td>3 Hrs</td>
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<td>IV</td>
<td>IV Theory</td>
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<td>Applied Microbiology</td>
<td>3 Hrs</td>
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<tr>
<td>IV Lab</td>
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<td></td>
<td>Applied Microbiology</td>
<td>3 Hrs</td>
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**Total number of hours for theory papers and labs in an academic year:**

- Theory Paper I: 120 Hrs  Lab I: 90 Hrs  (30 sessions)
- Theory Paper II: 120 Hrs  Lab II: 90 Hrs  (30 sessions)
- Theory Paper III: 90 Hrs  Lab III: 90 Hrs  (30 sessions)
- Theory Paper IV: 90 Hrs  Lab IV: 90 Hrs  (30 sessions)
Paper I: INTRODUCTORY MICROBIOLOGY

UNIT – I  History of Microbiology and Microscopy  30Hrs
Meaning, definition and history of Microbiology.  2 Hrs
Contributions of Antony von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Iwanowsky, Beijerinck, Winogradsky and Alexander Fleming.  10 Hrs
Importance and applications of Microbiology.  2 Hrs
Principles of microscopy – bright field, dark field, phase-contrast, fluorescent and electron microscopy (SEM and TEM). Ocular and stage micrometers.  10 Hrs
Size determination of microorganisms.  2 Hrs
Principles and types of stains - Simple stain, differential stain, negative stain, structural stains - spore, capsule, flagella. Hanging-drop method.  4 Hrs

UNIT – II  Microbiological Techniques  30 Hrs
Sterilization and disinfection techniques. Principles and methods of sterilization.  2 Hrs
Physical methods - autoclave, hot-air oven, pressure cooker, laminar air flow, filter sterilization.  5 Hrs
Radiation methods - UV rays, gamma rays, ultrasonic methods.  4 Hrs
Chemical methods - Use of alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites. Phenol coefficient.  5 Hrs
Isolation of pure culture techniques - Enrichment culturing, dilution-plating, spread-plate and micromanipulator.  8 Hrs
Preservation of microbial cultures - subculturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.  6 Hrs

UNIT – III  Biology of Prokaryotic and Eukaryotic Microorganisms  30 Hrs
Outline classification of living organisms: Heckel, Whittaker and Carl Woese systems.  6 Hrs
Place of microorganisms in the living world.  2 Hrs
Differentiation of prokaryotes and eukaryotes.  1 Hr
Prokaryotes - General characteristics of bacteria, archaebacteria, rickettsias, mycoplasmas, cyanobacteria and actinomycetes.  6 Hrs
Outline classification for bacteria as per the second edition of Bergey’s Manual of Systematic Bacteriology (up to section level).  2 Hrs
Ultrastructure of a bacterial cell: Invariant components - cell wall, cell membrane, ribosomes, nucleoid. Variant components - Capsule, flagella, fimbriae, endospore and storage granules. 6 Hrs

General characteristics and classification of viruses. Morphology and structure of TMV and HIV. 2 Hrs

Structure and multiplication of lambda bacteriophage. 2 Hrs

Eukaryotes - General characteristics and classification (up to the order level) of eukaryotic microorganisms - Protozoa, microalgae, molds and yeasts. 3 Hrs

UNIT – IV  Biomolecules 30 Hrs

Biomolecules of microorganisms. 1 Hr

Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides). 5 Hrs

General characteristics of amino acids and proteins. 5 Hrs

Structure of nitrogenous bases, nucleotides, nucleic acids. 5 Hrs

Fatty acids (saturated and unsaturated) and lipids (spingolipids, sterols and phospholipids). 5 Hrs

Hydrogen ion concentration in biological fluids, pH measurement. 3 Hrs

Types of buffers and their use in biological reactions. 3 Hrs

Principle and application of colorimetry and chromatography (paper and thin-layer). 3 Hrs

TEXT AND REFERENCE BOOKS:


LAB – I: INTRODUCTORY MICROBIOLOGY  

1. Precautions to work in Microbiology laboratory.
2. Preparation of culture media: Solid / Liquid.
4. Isolation of single colonies on solid media.
5. Enumeration of bacterial numbers by serial dilution and plating.
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram –ve bacilli), cyanobacteria (Nostoc, Spirulina), algae (Scenedesmus sp., diatoms), and fungi (Saccharomyces, Rhizopus, Aspergillus, Penicillium, Fusarium).
8. Calibrations of microscopic measurements (Ocular, stage micrometers).
9. Measuring dimensions of fungal spores
10. Simple and differential staining (Gram staining).
11. Spore staining, capsule staining and negative staining.
12. Diagramatic or Electron photomicrographic observation of TMV, HIV, T4 phage and adenovirus

REFERENCE BOOKS FOR LAB:


II Year  B.Sc.

Paper II: MICROBIAL PHYSIOLOGY AND GENETICS

UNIT – I  Nutrition, Growth and Enzymes  30 Hrs

Microbial nutrition - nutritional requirements and uptake of nutrients by cells. Nutritional groups of microorganisms - autotrophs, heterotrophs, mixotrophs, methylotrophs.

5 Hrs

Growth media - synthetic, nonsynthetic, selective, enrichment and differential media. Microbial growth - different phases of growth in batch cultures.  6 Hrs

Factors influencing microbial growth.  2 Hrs

Synchronous, continuous, biphasic growth.  3 Hrs

Methods for measuring microbial growth – Direct microscopy, viable count estimates, turbidometry, biomass.  4 Hrs

Enzymes - properties and classification, enzyme unit.  3 Hrs

Biocatalysis - induced fit, and lock and key model, coenzymes, cofactors, affecting catalytic activity of enzymes.  4 Hrs

Inhibition of enzyme activity - competitive, noncompetitive, uncompetitive and allosteric.  3 Hrs

UNIT – II  Intermediary Metabolism  30 Hrs

Aerobic respiration - Glycolysis, HMP pathway, ED pathway, TCA cycle, electron transport, oxidative and substrate-level phosphorylation. Anaplerotic reactions. \( \beta \)-Oxidation of fatty acids.  13 Hrs

Glyoxylate cycle. Anaerobic respiration (nitrate, sulphate respiration).  7 Hrs

Fermentation - Common microbial fermentations with special reference to alcohol and lactic acid fermentations.  5 Hrs

Photosynthetic apparatus in prokaryotes. Outlines of oxygenic and anoxygenic photosynthesis in bacteria.  5 Hrs

UNIT – III  Microbial Genetics  30 Hrs

Fundamentals of genetics - Mendelian laws, alleles, crossing over, and and RNA as genetic materials.  8 Hrs

Structure of DNA – Watson and Crick model.  2 Hrs

Extrachromosomal genetic elements – Plasmids and transposons.  2 Hrs

Replication of DNA – Semiconservative mechanism.  3 Hrs

Outlines of DNA damage and repair mechanisms.  4 Hrs
Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions. 4 Hrs

Various physical and chemical mutagens. 2 Hrs

Brief account on horizontal gene transfer among bacteria – transformation, transduction and conjugation. 5 Hrs

UNIT – IV Gene Expression and Recombinant DNA Technology 30 Hrs

Concept of gene – Muton, recon and cistron. One gene-one enzyme, one gene-one polypeptide, one gene-one product hypotheses. 4 Hrs

Types of RNA and their functions. 2 Hrs

Outlines of RNA biosynthesis in prokaryotes. 3 Hrs

Genetic code. Structure of ribosomes and a brief account of protein synthesis. 4 Hrs

Types of genes – structural, constitutive, regulatory. 2 Hrs

Operon concept. Regulation of gene expression in bacteria – lac operon. 3 Hrs

Basic principles of genetic engineering - restriction endonucleases, DNA polymerases and ligases, vectors. 3 Hrs

Outlines of gene cloning methods. 2 Hrs

Genomic and cDNA libraries. 3 Hrs

General account on application of genetic engineering in industry, agriculture and medicine. 4 Hrs

TEXT AND REFERENCE BOOKS:


LAB – II: MICROBIAL PHYSIOLOGY AND GENETICS  

1. Preparation of media for culturing autotrophic and heterotrophic microorganisms - Algal medium, mineral salts medium, nutrient agar medium, McConkey agar, and blood agar.
2. Enrichment culturing and isolation of phototrophs and chemoautotrophs.
3. Setting and observation of Winogradsky column.
5. Turbidometric measurement of bacterial growth.
6. Bacterial growth curve.
8. Qualitative analysis of sugars and amino acids.
10. Colorimetric estimation of proteins by Biuret/Lowry method
11. Paper chromatographic separation of sugars and amino acids
12. Starch hydrolysis, catalase test and sugar fermentation test.
13. Qualitative tests for sugars and amino acids.
14. Qualitative test and estimation of glucose.
15. Verification of Beer’s law.
16. Problems related to DNA and RNA characteristics, Transcription and Translation.

REFERENCE BOOKS FOR LAB:


**III Year   B.Sc.**

**Paper III: IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

### UNIT – I  History of Immunology and Immune System  22 Hrs
- Development of immunology.  
  2 Hrs
- Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity.  
  6 Hrs
- Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes.  
  6 Hrs
- Cells of immune system.  
  2 Hrs
- Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils.  
  6 Hrs

### UNIT – II  Basics of Immunology  22 Hrs
- Antigens – types, chemical nature, antigenic determinants, haptens.  
  2 Hrs
- Factors affecting antigenicity.  
  1 Hr
- Antibodies – basic structure, types, properties and functions of immunoglobulins.  
  2 Hrs
- Components of complement and activation of complement.  
  2 Hrs
- Types of antigen-antibody reactions – agglutination, blood groups, precipitation, neutralization, complement fixation.  
  4 Hrs
- Labeled antibody based techniques – ELISA, RIA and Immunofluoroscence.  
  3 Hrs
- Polyclonal and monoclonal antibodies – production and applications.  
  3 Hrs
- Types of hypersensitivity – immediate and delayed.  
  3 Hrs
- Autoimmunity and its significance.  
  2 Hrs

### UNIT – III  Clinical Microbiology  23 Hrs
- History of medical microbiology.  
  1 Hr
- Normal flora of human body.  
  2 Hrs
- Definition of infection, non-specific defense mechanisms, mechanical barriers, antagonism of indigenous flora.  
  3 Hrs
- Anti-bacterial substances – lysozyme, complement, properdin, antiviral substances, phagocytosis.  
  2 Hrs
- General principles of diagnostic microbiology.  
  1 Hr
- Collection, transport and processing of clinical samples.  
  3 Hrs
- General methods of laboratory diagnosis – cultural, biochemical, serological and molecular methods.  
  5 Hrs
- Tests for antimicrobial susceptibility.  
  2 Hrs
Antiviral agents – interferon and base analogues. 2 Hrs
Host-pathogen interactions. Bacterial toxins, virulence and attenuation. 2 Hrs

UNIT – IV Microorganisms and Diseases 23 Hrs
Elements of chemotherapy – therapeutic drugs. Drug resistance. 2 Hrs
Mode of action of penicillin and sulpha drugs, and their clinical use. 3 Hrs
Preventive control of diseases – active and passive immunization. 3 Hrs
Vaccines – natural and recombinant. 2 Hrs
General account of the following diseases – causal organisms, pathogenesis, epidemiology, diagnosis, prevention and control of:

- Air-borne diseases: Tuberculosis, Influenza
- Food and water-borne diseases: Cholera, Typhoid, Hepatitis- A, Poliomyelitis, Amoebiasis
- Insect-borne diseases: Malaria, Filariasis, Dengue fever
- Contact diseases: Syphilis, Gonorrhoea
- Zoonotic diseases: Rabies, Anthrax
- Blood-borne diseases: Serum hepatitis, AIDS 12 Hrs

General account of nosocomial infections. 1 Hr

TEXT AND REFERENCE BOOKS:


LAB – III: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

90 Hrs

1. Blood tests – TC, DC and ESR.
2. Estimation of blood haemoglobin.
3. Determination of blood groups and Rh typing.
5. Acid-fast staining of mycobacteria (stained/permanent slides).
6. Isolation and identification of medically important bacteria (E. coli, Klebsiella, Pseudomonas, Staphylococcus and Streptococcus) by cultural, microscopic and biochemical tests.
8. Parasites – Malarial parasite, Entamoeba (study of permanent slides).
9. Observation of fungal pathogen (Candida).
10. Tests for disinfectant (Phenol coefficient).

REFERENCE BOOKS FOR LAB:


Paper IV: APPLIED MICROBIOLOGY

UNIT - I  Agricultural Microbiology  23 Hrs
Physical and chemical characteristics of soil.  2 Hrs
Rhizosphere and phyllosphere.  1 Hr
Plant growth-promoting microorganisms - mycorrhizae, rhizobia, Azospirillum, Azotobacter, cyanobacteria, Frankia and phosphate-solubilizing microorganisms. Outlines of biological nitrogen fixation (symbiotic, non-symbiotic).  8 Hrs
Biofertilizers - Rhizobium.  1 Hr
Concept of disease in plants.  1 Hr
Symptoms of plant diseases caused by fungi, bacteria, and viruses.  3 Hrs
Plant diseases caused by fungi (groundnut rust), bacteria (angular leaf spot of cotton) and viruses (tomato leaf curl).  3 Hrs
Principles of plant disease control.  2 Hrs
Biological control of plant diseases. Biopesticides – Bacillus thuringiensis, Nuclear polyhedrosis virus (NPV), Trichoderma.  2 Hrs

UNIT – II  Environmental Microbiology  23 Hrs
Microorganisms of environment (soil, water and air).  2 Hrs
Role of microorganisms in nutrient cycling (carbon, nitrogen, sulphur).  4 Hrs
Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.  4 Hrs
Microbiology of potable and polluted waters. E. coli and Streptococcus faecalis as indicators of water pollution. Sanitation of potable water.  5 Hrs
Sewage treatment (primary, secondary and tertiary).  2 Hrs
Outlines of biodegradation of environmental pollutants – pesticides.  2 Hrs
Solid waste disposal – sanitary land fills, composting.  2 Hrs
Microbiology of air and air sampling methods.  2 Hrs

UNIT – III  Food Microbiology  22 Hrs
Microorganisms of food spoilage and their sources.  3 Hrs
Spoilage of different food materials - fruits, vegetables, meat, fish.  3 Hrs
Canned foods. Food intoxication (botulism and staph poisoning), food-borne diseases (salmonellosis and shigellosis) and their detection.  5 Hrs
General account of food preservation.  2 Hrs
Microbiological production of fermented foods – bread, cheese, yogurt.  3 Hrs
Biochemical activities of microbes in milk.  2 Hrs
Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw).  
Concept of probiotics.  

UNIT – IV  Industrial Microbiology  22 Hrs

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes.  
2 Hrs

Screening and isolation of industrially-important microorganisms.  
3 Hrs

Outlines of strain improvement.  
2 Hrs

Types of fermentation – aerobic, anaerobic, batch, continuous, submerged, surface, solid state.  
4 Hrs

Design of a stirred tank reactor fermentor. Fermentation media.  
3 Hrs

Industrial production of alcohols (ethyl alcohol), beverages (beer), enzymes (amylases), antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid), vitamins (B12), biofuels (biogas - methane).  
8 Hrs

TEXT AND REFERENCE BOOKS:


2. Isolation and enumeration of major groups of microorganisms from rhizosphere and nonrhizosphere.
4. Isolation of *Azospirillum* / *Azotobacter*.
5. Staining and observation of vesicular-arbuscular mycorrhizal (VAM) fungi.
6. Observation of plant diseases of local importance – Rusts, smuts, powdery mildews, tikka disease of groundnut, citrus canker, bhendi yellow vein mosaic, tomato leaf curl, little leaf of brinjal.
7. Isolation of antagonistic microorganisms by crowded plate technique.
8. Determination of biological oxygen demand (BOD) of polluted water.
9. Microbial testing of water by coliform test (multiple tube fermentation method).
10. Determination of microbiological quality of milk – MBRT.
11. Observation of different spoiled foods.
12. Isolation of fungi and bacteria from spoiled fruits and vegetables.
13. Alcohol production and estimation; Calculation of fermentation efficiency.
15. Citric acid production and estimation.
16. Estimation of ascorbic acid from fruit juices.

**REFERENCE BOOKS FOR LAB:**


