MBT- 101 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 48  CREDITS: 4

UNIT-I  No. of hours: 12

History and milestones in microbiology.
Contributions of Anton van Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky.
Importance and applications of microbiology.
Classification of microorganisms – Haeckel’s three Kingdom concept, Whittaker’s five kingdom concept, three domain concept of Carl Woese.
Outline classification of bacteria as per the second edition of Bergey’s Manual of Systematic Bacteriology.

UNIT – II  No. of hours: 10

General characteristics of Bacteria, Archaea, Mycoplasmas and Cyanobacteria.
Ultrastructure of Prokaryotic cell- Variant components and invariant components.
General characteristics of viruses.
Morphology, Structure and replication of TMV and HIV.

UNIT-III  No. of hours: 10

General characteristics and outline classification of Fungi, Algae and Protozoa.
Principles of microscopy - Bright field and Electron microscopy (SEM and TEM).

UNIT-IV  No. of hours: 8

Staining Techniques – Simple and Differential (Gram Staining and Spore Staining).
Sterilization and disinfection techniques - Physical methods – autoclave, hot-air oven, pressure cooker, laminar air flow, filter sterilization, Radiation methods – UV rays, Gamma rays.
Chemical methods – alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites.

UNIT –V  No. of hours: 8

Isolation of Microorganisms from natural habitats.
Pure culture techniques – dilution-plating, Streak-plate, Spread-plate, Pour-Plate and micromanipulator. Enrichment culturing.
Preservation of microbial cultures – subculturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature.
MBP- 101 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

TOTAL HOURS: 48
CREDITS: 2

1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for cultivation of bacteria
3. Preparation of culture media for cultivation of fungi
4. Sterilization of medium using Autoclave
5. Sterilization of glassware using Hot Air Oven
6. Light compound microscope and its handling
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), Cyanobacteria, Algae and Fungi.
8. Simple staining
9. Gram’s staining
11. Isolation of pure cultures of bacteria by streaking method.
12. Preservation of bacterial cultures by various techniques.
13. Diagramatic or Electron photomicrographic observation of TMV, HIV, T4 phage and Adenovirus

SUGGESTED READING


Gopal Reddy et al Laboratory *Experiments in Microbiology*


B.Sc MICROBIOLOGY (CBCS) SYLLABUS
FIRST YEAR – SEMESTER- II

MBT- 201 : MICROBIAL BIOCHEMISTRY & METABOLISM

TOTAL HOURS: 48 CREDITS: 4

UNIT-I
No. of hours: 10

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)
lipids (sphingolipids, sterols and phospholipids).

UNIT-II
No. of hours: 8

Principle and applications of -
Colorimetry
Chromatography (paper, thin-layer and column),
Spectrophotometry (UV & visible),
Centrifugation and
Gel Electrophoresis.

UNIT-III
No. of hours: 10

Properties and classification of Enzymes.
Biocatalysis- induced fit and lock and key models.
Coenzymes and Cofactors.
Factors affecting catalytic activity.
Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

UNIT-IV
No. of hours: 10

Microbial Nutrition –Nutritional requirements and uptake of nutrients by cells.
Nutritional groups of microcroorganisms- autotrophs, heterotrophs, mixotrophs.
Growth media- synthetic, complex, selective, enrichment and differential media.
Microbial Growth- different phases of growth in batch cultures, Synchronous, continuous, biphasic growth.
Factors influencing microbial growth.
Methods for measuring microbial growth – Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT-V
No. of hours: 10

Aerobic respiration -Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport, oxidative and substrate level phosphorylation.
Anaerobic respiration (Nitrate).
Fermentation - Alcohol and lactic acid fermentations.
Outlines of oxygenic and anoxygenic photosynthesis in bacteria.

MBP- 201: MICROBIAL BIOCHEMISTRY & METABOLISM

TOTAL HOURS: 48  CREDITS: 2

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Aminoacids
3. Colorimetric estimation DNA by diphenylamine method
4. Colorimetric estimation of proteins by Biuret/Lowry method
5. Paper chromatographic separation of sugars and amino acids
6. Preparation of different media- Synthetic and Complex Media
7. Setting and observation of Winogradsky column.
10. Factors affecting bacterial growth – pH.
12. Factors affecting bacterial growth – Salts

SUGGESTED READING


Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone


UNIT-I
No. of hours: 10

DNA and RNA as genetic material.
Structure and organization of prokaryotic DNA.
Extrachromosomal genetic elements – Plasmids and transposons.
Replication of DNA – Semi conservative mechanism, Enzymes involved in replication.

UNIT-II
No. of hours: 10

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.
Mutagens - Physical and Chemical mutagens.
Outlines of DNA damage and repair mechanisms.
Genetic recombination in bacteria – Conjugation, Transformation and Transduction.

UNIT-III
No. of hours: 10

Concept of gene – Muton, Recon and Cistron. One gene one enzyme and one gene one polypeptide hypotheses.
Types of RNA and their functions.
Genetic code.
Structure of ribosomes.

UNIT-IV
No. of hours: 8

Types of genes – structural, constitutive, regulatory
Protein synthesis – Transcription and translation.
Regulation of gene expression in bacteria – lac operon.

UNIT-V
No. of hours: 10

Basic principles of genetic engineering.
Restriction endonucleases, DNA polymerases and ligases.
Vectors.
Outlines of gene cloning methods.
Polymerase chain reaction. Genomic and cDNA libraries.
General account on application of genetic engineering in industry, agriculture and medicine.
MBP- 301 MICROBIAL GENETICS AND MOLECULAR BIOLOGY

TOTAL HOURS: 48  CREDITS: 2

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from E. coli
4. Estimation of DNA using UV spectrophotometer.
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
7. Problems related to DNA and RNA characteristics, Transcription and Translation.
8. Induction of mutations in bacteria by UV light.
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR

SUGGESTED READING


B.Sc MICROBIOLOGY (CBCS) SYLLABUS
SECOND YEAR – SEMESTER- IV

MBT- 401 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 48

CREDITS: 4

UNIT-I

No. of hours: 10

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

No. of hours: 10


UNIT-III

No. of hours: 10


UNIT-IV

No. of hours: 8


UNIT-V

No. of hours: 10
General account on microbial diseases – causal organism, pathogenesis, epidemiology, diagnosis, prevention and control
Bacterial diseases – Tuberculosis and Typhoid
Fungal diseases – Candidiasis.
Protozoal diseases – Malaria.
Viral Diseases - Hepatitis- A and AIDS

MBP- 401 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 48                                      CREDITS: 2

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Estimation of blood haemoglobin.
4. Total Leukocyte Count of the given blood sample.
5. Differential Leukocyte Count of the given blood sample.
6. Immunodiffusion by Ouchterlony method.
7. Identify bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests.
8. Isolation of bacterial flora of skin by swab method.
10. Study symptoms of the diseases with the help of photographs: Anthrax, Polio, Herpes, chicken pox, HPV warts, Dermatomyces (ring worms).
11. Study of various stages of malarial parasite in RBCs using permanent mounts.

SUGGESTED READING


UNIT - I
No. of hours: 8
Terrestrial Environment: Soil profile and soil microflora
Aquatic Environment: Microflora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes
Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

UNIT – II
No. of hours: 8
Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus).
Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique.Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

UNIT – III
No. of hours: 6
Outlines of Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill).
Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

UNIT – IV
No. of hours: 7
Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, Azospirillum, Azotobacter, Frankia, phosphate-solubilizers and Cyanobacteria.
Outlines of biological nitrogen fixation (symbiotic, non-symbiotic).
Biofertilizers - Rhizobium.

UNIT – V
No. of hours: 7
Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases - groundnut rust, Citrus canker and tomato leaf curl.
Principles of plant disease control.
TOTAL HOURS: 36

2. Isolation of microbes (bacteria and fungi) from soil.
4. Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination of coliform count in water by MPN.
5. Determination of Biological Oxygen Demand (BOD) of waste water samples.
6. Isolation of Rhizobium from root nodules.
7. Staining and observation of Vesicular Arbuscular Mycorrhizal (VAM) fungi.
8. Observation of plant diseases of local importance - Citrus canker, Tikka disease of Groundnut, Bhendi yellow vein mosaic, Rusts, Smuts, Powdery mildews, Tomato leaf curl.

SUGGESTED READINGS


B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – SEMESTER -VIA

MBT- 601 MICROBIAL DIAGNOSIS IN HEALTH CLINICS

TOTAL HOURS: 36  CREDITS: 3

UNIT- I  No. of hours: 8

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

UNIT- II  No. of hours: 8

Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required.
Method of transport of clinical samples to laboratory and storage.

UNIT- III  No. of hours: 8

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria
Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

UNIT- IV  No. of hours: 6

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes.
Typhoid, Dengue and HIV, Swine flu.

UNIT- V  No. of hours: 6

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method,
Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

MBP- 601 MICROBIAL DIAGNOSIS IN HEALTH CLINICS
1. Collection transport and processing of clinical specimens (Blood, Urine, Stool and Sputum).
   Receipts, Labeling, recording and dispatching clinical specimens.

2. Isolation of bacteria in pure culture and Antibiotic sensitivity.

3. Identification of common bacteria by studying their morphology, cultural character, Biochemical reactions, slide agglutination and other tests.


**SUGGESTED READING**


Randhawa, VS, Mehta G and Sharma KB (2009) *Practicals and Viva in Medical Microbiology* 2nd edition, Elsevier India Pvt Ltd

B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – SEMESTER- VIB

MBT- 601 MICROBIAL BIOTECHNOLOGY

TOTAL HOURS: 36

UNIT- I
No. of Hours: 8
Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
Genetically engineered microbes for industrial application: Bacteria and yeast

UNIT- II
No. of Hours: 7
Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine).
Microbial polysaccharides, polyesters and bioplastics.
Microbial production of bio-pesticides
Microbial biosensors

UNIT- III
No. of Hours: 10
Microbial based transformation of steroids and sterols.
Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.
Immobilization methods and their application: Whole cell immobilization

UNIT- IV
No. of Hours: 7
Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass.
Mineral recovery, removal of heavy metals from aqueous effluents

UNIT- V
No. of Hours: 4
Outlines of Intellectual Property Rights: Patents, Copyrights, Trademarks
1. Yeast cell immobilization in calcium alginate gels
2. Enzyme immobilization by sodium alginate method
3. Pigment production from fungi (Trichoderma / Aspergillus / Penicillium)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

SUGGESTED READING


B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – SEMESTER- VII

MBT- 701 FOOD AND INDUSTRIAL MICROBIOLOGY

TOTAL HOURS: 36
CREDITS: 3

UNIT- I
No. of hours: 8
Intrinsic and extrinsic parameters that affect microbial growth in food
Microbial spoilage of food - fruits, vegetables, milk, meat, egg, bread and canned foods
Food intoxication (botulism).
Food-borne diseases (salmonellosis) and their detection.

UNIT – II
No. of hours: 7
Principles of food preservation - Physical and chemical methods.
Fermented Dairy foods – cheese and yogurt.
Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw). Probiotics and their benefits.

UNIT – III
No. of hours: 6
Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes.
Isolation and Screening of industrially-important microorganisms.
Outlines of strain improvement.

UNIT – IV
No. of hours: 8
Types of fermentation processes – solid state, liquid state, batch, fed-batch, continuous.
Design of fermenter.
Ingredients of Fermentation media
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT – V
No. of hours: 7
Microbial production of Industrial products - Citric acid, Ethanol, amylases, penicillin, glutamic acid and vitamin B12.
1. Isolation of bacteria and fungi from spoiled bread/fruits/vegetables

2. Preparation of Yogurt/Dahi

3. Determination of the microbiological quality of milk sample by MBRT

4. Isolation of antagonistic microorganisms by crowded plate technique

5. Design of Fermenter

6. Microbial fermentation for the production and estimation of ethanol from Grapes.

7. Microbial fermentation for the production and estimation of citric acid.

**SUGGESTED READING**


MBT- 801 MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

TOTAL HOURS: 36 CREDITS: 3

UNIT – I
No. of Hours: 8

Good laboratory practices - Good microbiological practices. 
Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

UNIT – II
No. of Hours: 8

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

UNIT – III
No. of Hours: 8

Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – IV
No. of Hours: 8

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, 
Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar 
Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

UNIT – V
No. of Hours: 4

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitationsMicrobial Standards for Different Foods and Water – BIS standards for common foods and drinking water.
MBP- 801 MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

TOTAL HOURS: 36

1. Microbiological laboratory safety- General rules & Regulations.
2. Sterility tests for Instruments – Autoclave & Hot Air Oven
3. Disinfection of selected instruments & Equipments
4. Sterility of Air and its relationship to Laboratory & Hospital sepsis.
5. Sterility testing of Microbiological media
6. Sterility testing of Pharmaceutical products – Antibiotics, Vaccines & fluids
7. Standard qualitative analysis of water.
8. Quantitative analysis of water – Membrane filter method
9. Analysis of food samples for Mycotoxins

SUGGESTED READING

Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.


Microbiology - A laboratory manual, Cappuccino & Sherman , 6 th Ed, Pearson Education

Pharmaceutical Microbiology – Purohit

Pharmaceutical Microbiology – W.B. Hugo
B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – SEMISTER-VIIB

MBT- 801 BIOFERTILIZERS AND BIOPESTICIDES

TOTAL HOURS: 36

CREDITS: 3

UNIT – I

No of Hours: 10

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N\textsubscript{2} fixers: \textit{Rhizobium} - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

\textit{Frankia} from non-legumes and characterization.

Cyanobacteria from \textit{Azolla}, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II

No of Hours: 6

Free living \textit{Azospirillum, Azotobacter} - isolation, characteristics, mass inoculum production and field application.

UNIT – III

No of Hours: 6

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

UNIT – IV

No of Hours: 7

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V

No of Hours: 7

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides. \textit{Bacillus thuringiensis} - production, Field applications.

Viruses – NPV cultivation and field applications.
MBP- 801 BIOFERTILIZERS AND BIOPESTICIDES

TOTAL HOURS: 36  CREDITS: 2

1. Isolation of *Rhizobium* from root nodules.

3. Isolation of phosphate solubilizers from soil

4. Staining and observation of VAM

3. A visit to biofertilizer production unit.

SUGGESTED READINGS


SUBJECT: MICROBIOLOGY
MODEL PAPER FOR SEMESTER END EXAMINATION

Time : 3 hrs                         Max. Marks : 75

Section – A

I     ANSWER ANY FIVE OF THE FOLLOWING  5 x 5 = 25 marks
      Draw labeled diagrams wherever necessary

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

Section – B

II    ANSWER ANY FIVE OF THE FOLLOWING    5 x 10 = 50 marks
      Draw labeled diagrams wherever necessary

9    a) Or
    b) 

10   a) Or
    b) 

11   a) Or
    b) 

12   a) Or
    b) 

13   a) Or
    b)