Syllabus
For
M.Sc. Microbiology
(Four Semester Course for Colleges)

Academic Session

July (2017-2019)

Jiwaji University, Gwalior
(NAAC accredited ‘A’ grade University)
## Scheme of Examination

### M.Sc. I Semester

<table>
<thead>
<tr>
<th>No. of papers.</th>
<th>Name of papers</th>
<th>Max. Marks</th>
<th>Theory</th>
<th>CCE</th>
<th>Minimum pass marks in theory paper</th>
<th>Minimum practical passing marks</th>
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<tbody>
<tr>
<td>MB:101</td>
<td>Basics in Microbiology and General Bacteriology</td>
<td>100</td>
<td>85</td>
<td>15</td>
<td>29</td>
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<tr>
<td>MB:102</td>
<td>Virology and Mycology</td>
<td>100</td>
<td>85</td>
<td>15</td>
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<tr>
<td>MB:103</td>
<td>Cell biology and Biochemistry</td>
<td>100</td>
<td>85</td>
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<tr>
<td>MB:104</td>
<td>Bioinstrumentation</td>
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<td>85</td>
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<tr>
<td>MB:105</td>
<td>Lab course-1</td>
<td>100</td>
<td>-</td>
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<tr>
<td>MB:106</td>
<td>Lab course-2</td>
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### M.Sc. II Semester

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<th>Theory</th>
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<th>Minimum pass marks in theory paper</th>
<th>Minimum practical Passing marks</th>
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<tbody>
<tr>
<td>MB:201</td>
<td>Microbial genetics and Molecular biology</td>
<td>100</td>
<td>85</td>
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<tr>
<td>MB:202</td>
<td>Immunology</td>
<td>100</td>
<td>85</td>
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<tr>
<td>MB:203</td>
<td>Microbial Physiology and Metabolism</td>
<td>100</td>
<td>85</td>
<td>15</td>
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<tr>
<td>MB:204</td>
<td>Biostatistics, Computer application and Bioinformatics.</td>
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### M.Sc. III Semester

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<th>No. of papers</th>
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<th>Max. Marks</th>
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<th>CCE</th>
<th>Minimum pass marks in theory paper</th>
<th>Minimum practical passing marks</th>
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<td>MB:301</td>
<td>Medical and Pharmaceutical Microbiology</td>
<td>100</td>
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<tr>
<td>MB:302</td>
<td>Recombinant DNA technology</td>
<td>100</td>
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<tr>
<td>MB:303</td>
<td>Fermentation and microbial technology</td>
<td>100</td>
<td>85</td>
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<tr>
<td>MB:304</td>
<td>Environmental microbiology</td>
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<td><strong>Total</strong></td>
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### M.Sc. IV Semester

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<th>No. of papers</th>
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<th>Minimum practical passing marks</th>
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<td>MB:401</td>
<td>Agriculture microbiology</td>
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<td>MB:402</td>
<td>Food microbiology</td>
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<td>85</td>
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<tr>
<td>MB:403</td>
<td>Lab course</td>
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<td>-</td>
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<tr>
<td>MB:404</td>
<td>Project work of 3-4 months duration</td>
<td>300</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>170</strong></td>
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MB: 101 BASICS IN MICROBIOLOGY AND BACTERIOLOGY

UNIT-I

1. Introduction, history and scope of Microbiology.
2. General characteristics and composition of Prokaryotes and Eukaryotes.

UNIT-II

2. Components external to cell wall: Structure and function of flagella, fimbriae and pilli, capsule- types, composition and function, slime layers, S-layers.
3. Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeobacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid.

UNIT-III

1. Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.

UNIT-IV

1. General concept of Prokaryotic and Eukaryotic genome. Genome of E.coli.
2. Genetic recombination and transformation.
3. Transduction: generalized and specialized transduction, phage conversion.


**UNIT-V**

1. Staining methods: fixation, types of dyes, simple staining, differential staining (Gram and Acid-fast staining), staining of specific structures (capsule, flagella and spore staining)

2. Control of microorganisms: Microbial death curve, concept of bio-burden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents.

3. Control of microorganisms by physical agents: heat (moist and dry), filtration and radiation.

4. Chemical control of microorganisms: Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

**Reference Books**


8. Microbiology An rodution by Tortora Funke case.
MB: 102 VIROLOGY AND MYCOLOGY

UNIT-I
1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II
1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods, plaque method, pock counting and end point method.
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA.

UNIT-III
1. Plant viruses: recent advance in classification of plant viruses. Structure and pathogencity of TMV.
2. Transmission of plant viruses with vector (insect, nematods and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.
4. General idea about Cyanophage, and Mycophage.

UNIT-IV
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle: lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T4, Ø x174 and lambda phage
UNIT-V
1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.

2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.

3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.


Reference Books

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA


MB: 103 CELL BIOLOGY AND BIOCHEMISTRY

UNIT-I
2. Structural organization and function of intracellular organelles of eukaryotic cell: nucleus, mitochondria, golgibody, lysosomes, endoplasmic reticulum, peroxisomes, plastids, chloroplast, vacuole, cytoskeleton.

UNIT-II

UNIT-III
1. Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars.
2. Structure, properties and function of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins, glycolipids.
3. Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes.
4. Lipids with specific biological functions, micelles and liposomes.

UNIT-IV
1. Amino acids: structure, classification, properties and functions.
4. Basic structure and types of DNA and RNA.
UNIT-V

1. Enzymes: basic concept as a biocatalyst, specificity, active sites, activity unit and isoenzymes, enzyme classification.
2. Enzyme kinetics- Michaelis-Menton equation for simple enzymes, determination of kinetic parameters.
4. Vitamins and cofactors: structure, distribution and biological properties.

Reference books

MB: 104 BIOINSTUMENTATION

UNIT-I
1. Microscopy: history and principles of microscopy, properties of light, magnification power, resolution limit, resolving power, numerical aperture.
2. Principles and applications of light microscopy, bright field, dark field, phase contrast and fluorescent microscopy. Determination of size of microorganisms by micrometry.

UNIT-II
1. Chromatography: Principles, types and applications of partition, paper and thin layer chromatography.
2. Adsorption and Gel filtration chromatography: Principle, matrix, column packing and applications.
3. Affinity, ion exchange, and Gas chromatography: Principle and applications.
4. High performance liquid chromatography (HPLC) and FPLC: Principle, Instrumentation (Reservoirs, pumps, columns) and applications.

UNIT-III
1. Electrophoresis: principle, types and applications of Paper, Starch gel and Agarose gel electrophoresis.
2. Polyacrylamide Gel Electrophoresis: Native PAGE and SDS PAGE
3. Isoelectric focusing, Isotachophoresis and gradient gel electrophoresis.
4. Two dimensional gel electrophoresis and pulse field gel electrophoresis.

UNIT-IV
2. Principles, instrumentation and applications Infrared and fluorescence Spectroscopy.
3. Principles, instrumentation and applications of NMR and ESR.
4. Principle, instrumentation and applications Mass Spectroscopy (types of ion source, analyzers and detectors), GC-MS, MALDI-TOF.
UNIT-V
2. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.
3. Radioisotope techniques: half life, radioactive decay, radioactive assay methods based on ionization and excitation of gases-Geiger Muller counter, liquid scintillation counter and gamma counter.
4. Autoradiography- principle and applications. Quenching and application of radioisotopes in biological systems.

Reference Books
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Frefelder,
4. Principles of Instrumental Analysis, Skoog and West
5. Biological Spectroscopy, Campbell and Dwek
MB: 105 Lab course I (Basics in Microbiology and Bacteriology & Virology and Mycology)

1. Good Microbiology laboratory practices: Laboratory safety (Dos and Don’ts), hazard from chemicals, handling of cultures and chemicals, disposal of chemicals and cultures.

2. Introduction to different Glass wares used in Microbiology Laboratory.

3. To learn handling of different instruments and Equipments used for culture and Sterilization.

4. To prepare basic liquid (Nutrient broth) and basic solid media (Nutrient Agar and Potato Dextrose Agar) for cultivation of bacteria and fungi.

5. To prepare selective, differential media and enriched media (MacConkey Agar and Blood Agar)

6. To learn pure culture techniques used for isolation and purification of microorganisms
   a. Streak plate method
   b. Pour plate method
   c. Spread plate method

7. Isolation and Enumeration of microorganisms from Air (plate exposure method), Soil and Water (serial dilution method)

8. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi
   a. Gram Staining
   b. Acid fast staining
   c. Fungal staining (Lacto-phenol cotton blue)
   d. Spore staining
   e. Flagella staining
   f. Capsule staining (Negative staining)

9. To check motility of bacteria by hanging drop and semi solid agar methods

10. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks)

11. To study effect of salt, pH and temperature on microbial growth
12. Determination of bacterial growth by turbidity measurements and to plot bacterial growth curve.

13. Inoculation and cultivation of viruses in embryonated eggs.


15. Enumeration of bacteriophage by plague forming unit method

16. Determination of one step growth curve of bacteriophage

17. Isolation cultivation and morphological studies of fungi

18. Isolation cultivation and morphological studies of Actinomycetes
MB: 106 Lab course II (Cell biology and Biochemistry & Bioinstrumentation)

1. To detect the presence of carbohydrate in the given sample by Molish test
2. To detect the presence of reducing sugar in the given sample by Fehling’s test
3. To detect the presence of pentose sugar in the given sample by Bial’s test
4. To determine the presence of monosaccharide using Anthrone test
5. To detect presence of reducing sugar using Benedict’s test.
6. To determine the presence of monosaccharide using Barfoed’s reagent
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test)
8. To determine the presence of ketose sugar by Seliwanoff’s reagent in given sample
9. To determine the presence of protein by Biuret method
10. To determine the presence of protein by Xanthoprotic test.
11. Quantification of protein contents in given sample by Folin’s- Lowry method
12. To determine Saponification value of given fat sample
14. To study different stages of mitosis in onion root tip preparations
15. Verification of Beer-Lambert Law
17. Calibration of an ocular micrometer for different objectives of microscope.
18. Measurement of microorganisms by the use of an ocular micrometer.
19. Separation of given amino acids by paper chromatography
20. Separation of amino acids by Thin Layer Chromatography
21. To study microorganisms under dark-field microscope
22. Separation of sub cellular organelles by differential centrifugation
MB: 201 MICROBIAL GENETICS AND MOLECULAR BIOLOGY

UNIT-I
1. Organization of genetic material in prokaryotes and eukaryotes.
2. Concept of gene, genome, genome size, C-value, and C-value paradox.
3. Nucleic acid as a genetic information carriers; experimental evidence.
4. Gene is a unit of mutation and recombination; molecular basis of mutations, physical and chemical mutagens, spontaneous and induced mutation, selection of mutant.

UNIT-II
1. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
2. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine diamers.), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
3. DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polymerases, DNA ligase, primase.

UNIT-III
1. Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA.
2. Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.
3. Control of Transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination; Rho dependent and Rho independent.
4. Post transcriptional modification, maturation and splicing of RNA transcripts, catalytic RNA.
UNIT-IV
1. Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
2. Protein synthesis: steps, details of initiation, elongation and termination.
3. Inhibitors of protein synthesis: signal hypothesis.

UNIT-V
1 Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter, repressor, induction and repression, positive and negative control.
2 Lac-operon, ara-BAD operon, trp operon, attenuation, mechanism of regulation of transcription.
3 Regulation of gene expression in eukaryotes: Britton and Davidson’s model of regulation involve HCP and NHCP and hormones.
4 Transposable elements.

Reference Books
5. Genomes by T.A. Brown, John Wiley and sons (Asia)PTE LTD, New York.
9. An Introduction to Genetic Analysis, Griffiths et al., W. H. Freeman
MB: 202 IMMUNOLOGY

UNIT-I
1. History of immunology, development of immunology as discipline.

UNIT-II
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, superantigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes. Molecular mechanism of antibody diversity and class switching.

UNIT-III
1. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
3. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors.
4. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.
UNIT-IV
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

UNIT-V
1. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotypic vaccine.
2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basis research.
3. Antibody engineering: Chimeric and Humanized monoclonal antibodies.
4. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen-antibody interaction by precipitation, agglutination, RIA, and ELISA.

Reference Books
MB: 203 MICROBIAL PHYSIOLOGY AND METABOLISM

UNIT-I

1. Bioenergetics and metabolism: Basic concepts.
2. First and second law of thermodynamics, concept of free energy, entropy and enthalpy.
3. High energy phosphate compounds, role of ATP, ATP cycle, structural basis of free energy change during hydrolysis of ATP.
4. Biological redox reactions, Biological reducing power and its role in biological system.

UNIT-II

2. Pentose phosphate pathway, E-D pathway, Kreb’s cycle and glyoxalate pathway.
3. Electron transport system in Mitrochondria, Electron cariers and multienzyme complex I to IV.
4. ATP synthesis: substrate level and oxidative phosphorylation and un-couplers, inhibitors of oxidative phosphorylation.

UNIT-III

3. Lipid biosynthesis: Biosynthesis of lipids and fatty acids, triglycerol and phospholipids and their regulation
4. Lipid Metabolism: Degradation of Lipids, oxidation of unsaturated, saturated, even and odd chain fatty acids, ketone bodies.
UNIT-IV
2. Catabolism of amino acids: Breakdown of amino acids into six common intermediates and urea cycle and relationship with TCA cycle: Outlines.
3. Nucleotide metabolism: Biosynthesis of purines and pyrimidines nucleotides by de novo and salvage pathways.

UNIT-V
1. Nitrification, denitrification, Nitrate and ammonia assimilation pathways, Nitrogen cycle.
2. Diazotrophs and Biochemistry of nitrogen fixation, Structure of nitrogenase complex.
3. Regulation of nitrogenase complex by oxygen and combined nitrogen sources.
4. Nif genes and their regulation.

Reference Books
MB: 204 BIOSTATISTICS, COMPUTER APPLICATION & BIOINFORMATICS

UNIT–I
1. Definition of statistics and scope of statistics in bio research.
2. Types of sampling methods, survey design, organization and graphical representation of data.
3. Measures of central tendency
4. Measure of dispersion, correlation, calculation of Karl Pearson’s coefficient of correlation, theory of multiple correction and property.

UNIT–II
1. Regression Analysis, linear regression, regression equation
2. Hypothesis testing: Types of hypothesis testing: t-test, 2 -test, and F- test.
3. Introduction of Design of Experiment (DOC) and factorial design.
4. Application of SPSS software.

UNIT–III
1. History & development of computer organization of a basic computer. computer application in molecular biology.
2. Number system, computer arithmetic & Boolean algebra.
3. Type of operating systems, DOS, WINDOWS & LINUX. Introduction to MS Office.
4. Basic concept of programming; algorithm, flow charts & introduction to computer languages, basic idea of internet . use of various software in microbiology.

UNIT–IV
3. Sequence Database: EMBL, DDBJ, GenBank, UniGen, PIR, SWISS-PROT and TrEMBL. Structure Database: PDB, CATH, DALI, SCOP.
4. Data mining tools: Modelling tools ( Rasmol, SPDV, HyperChem), Data submition tools (Bankit, Sequin, Webin, Sukura, Spin, AutoDep).
UNIT–V


4. Proteomics: Proteome analysis, Tools for Protein sequence analysis and proteomics (PSI- BLAST, CD search, CDART), structure analysis (Cn3D, CD search).

References Books


8. Introduction to Bioinformatics by Teresa. K. Attwood and David J. Parry- Smith, Low Price edition, Pearson Education
205: LAB COURSE-I (MICROBIAL GENETICS AND MOLECULAR BIOLOGY & IMMUNOLOGY)

1. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
2. To isolate and produce UV induced auxotrophic mutants by replica plating method.
3. Demonstration of genetic recombination in bacteria by conjugation.
4. To perform Ames test for detecting carcinogen or mutagen.
5. Quantification of DNA by DPA method.
6. Quantification of RNA by Orsinol method.
7. To check purity and quantity of DNA by Spectrophometric method.
8. To isolate genomic DNA from Gram positive and Gram Negative bacteria.
9. To isolate total RNA and mRNA from bacteria.
10. To perform SDS-PAGE for separation of proteins in given sample.
11. To prepare soluble antigen by different methods.
12. To demonstrate various routes of immunization in mice.
13. To prepare serum and plasma from blood.
14. To precipitate immunoglobulins by ammonium sulphate from and to determine total protein contents.
15. To determine Blood group and Rh factor by slide agglutination test.
16. To determine Total Leukocyte Count (TLC) for given blood sample.
17. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman's stain.
18. To perform Widal agglutination test (slide and tube) for diagnosis of typhoid.
19. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
20. To perform Redial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
21. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction.
22. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction.
23. To perform ELISA for assay of antibodies in serum sample against given antigen.
206: Lab course - II (Microbial Physiology and Biostatistics, Computer Application and Bioinformatics)

1. To study catalase activity of given microbial culture.
2. To study oxidase activity of given microbial culture.
3. To study ability of microorganisms to hydrolyse casein.
4. To demonstrate phenlalanine deaminase activity of given bacterial culture.
5. To demonstrate L-lysine decarboxylase activity of bacterial culture.
6. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms.
7. To demonstrate Fat hydrolysis (lipase activity) by bacteria.
8. To study ability of microorganisms to hydrolyze gelatin.
9. To demonstrate degradation of sulphur containing amino acids by bacteria.
10. Representation of statistical data by
   1. Histogram
   2. O give curves
   3. Pie diagrams
11. Collection of data using different sampling methods.
12. Determination of Averages or Central tendencies (Mean, Mode, Median).
13. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation).
16. To access scientific data from Literature data bases (PUBMED, LITDB, Medline).
17. To access nucleic acid databases for retrieval of gene sequence.
18. To access protein databases for retrieval of amino acid sequence of target protein.
19. To perform pair wise sequence alignment using Dot matrix.
20. To perform multiple sequence alignment using BLAST.
21. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
22. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W.
23. 3D protein structure prediction and structure refinement using Swiss-PDB viewer.
MB: 301 MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

UNIT-I

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.
2. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.
4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

UNIT-II

1. Infections caused by Gram positive cocci and Gram negative cocci: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of Staphylococcus, Streptococcus and Neisseria (meningitis, gonorrhea)
2. Infections caused by Gram negative bacteria of family Enterobacteriaceae: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of E.coli, Klebsiella, Proteus, Pseudomonas, Shigella dysenteriae and Salmonella typhi.
3. Infection caused by Gram Positive bacilli: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of Corynebacterium diphtheriae, Bacillus anthracis, Clostridium tetani, Vibrio cholerae.

UNIT-III

Morphology, pathogenesis, immune response, diagnosis and prevention of
1. Pox viruses (Variola, Vaccinia, Small pox) Herpes Simplex type I and type II, Picorna viruses (Enteroviruses and Polioviruses).
2. Paramyxvo viruses (Rubulavirus and Parainfluenza viruses), Orthomyxoviruses (Measles & Mumps viruses).
3. Hepatitis viruses (Type A, B, C, D, E), Arboviruses (Alphavirus and Flaviviruses), Rhabdo viruses (Rabies virus).
4. Oncogenic viruses, HIV virus.
UNIT-IV

1. Important protozoal diseases: Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Plasmodium vivax*, *P. falciparum*, *P. malariae* (Malaria), *Entamoeba histolytica* & *Entamoeba Coli* (amoebiasis),

2. Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania*, *Trypanosoma* and *Toxoplasma*.

3. Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)

4. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

UNIT-V

1. Antimicrobial agents: History, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action)

2. Methodologies for testing of antibacterial, antifungal, and antiviral drugs (*in vivo* and *in vitro* infectivity models), mechanism drug resistance.

3. Preclinical development: Safety profile of drugs (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and neurotoxicity), Toxicological evaluation of drug (LD50, Acute, subacute and chronic toxicity), Mutagenecity (Ames test, micronucleus test) and Carcinogenicity.

Reference Books


4. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA


6. Medical Microbiology; Jawetz, Melnick, & Adelberg's, Fifth edition, MacGrow Hills

7. Medical Bacteriology, Medical Mycology and AIDS; N.C.Dey, T.K. Dey and D. Sinha, New Central Book Ajency (P) Ltd.


MB: 302 RECOMBINANT DNA TECHNOLOGIES

UNIT-I
1. Enzymes used in DNA technology: Restriction and modification enzymes, nuclease, polymerases, ligase, kinases and phosphatases. Linkers and adapters.
2. Cloning vectors: Plasmids, Phages (Lambda and M13) Phgmids, Cosmids and Expression vectors.
3. Cloning vectors for Yeast (shuttle vector and YAC) and cloning vector for animal cells: SV 40, Vaccinia and Retroviruses.

UNIT-II
1. Genomic and cDNA library.
2. Screening of clones from libraries: Expression based screening, Interaction based screening.
4. Mutagenesis: Site directed mutagenesis, Transposon mutagenesis.

UNIT-III
1. DNA Sequencing: Sangers method, Maxmam Gilbert method, Thermo cycle sequencing and Pyrosequencing
3. Oligonucleotide synthesis, Restriction mapping, S1 nuclease and RNase mapping.
4. Polymerase Chain Reaction (PCR): Principle, Types and variants of PCR (Touch-Down PCR, Hot start PCR, Inverse PCR, RT-PCR, multiplex PCR, nested PCR), Real time PCR.
UNIT IV
1. Molecular typing: RFLP (Ribotyping, IS based), RAPD, AFLP, VNTR, SNP, Whole genome sequence: GIS
2. Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility, shift assay, DNA foot-printing & DNA fingerprinting.
3. Transgenic animals: Strategies and methods.

UNIT-V
1. Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics, recombinant and DNA vaccines.
3. Applications of Recombinant DNA Technology in Agriculture and Industry.
4. Biosafety & ethical considerations for GMOs.
Reference Books


MB: 303 FERMENTATION AND MICROBIAL TECHNOLOGY

UNIT-I
1. Industrially important strains of bacteria, fungi, and actinomycetes. Novel microbes for future industry.
2. Isolation and screening of the industrially important strain from diverse ecosystem.
3. Method of strain improvement, mutagenesis, strain breeding by protoplast fusion, sexual and parasexual recombination.

UNIT-II
1. Downstream processing: filtration of fermentation broths recovery of biological products by distillation, superficial fluid extraction.
2. Detection, analysis and quality control of fermentation products and raw materials.
3. Industrial production of alcohols: vinegar, wine and alcohol.
4. Industrial production of solvents-glycerol, acetone, and butanol.

UNIT-III
1. Industrial production of citric acid and glutamic acid.
2. Microbial production of enzyme of industrial important: amylase and proteases.
3. Methods of whole cell immobilization, enzyme immobilization and application.
4. Industrial production of antibiotics, penicillin and streptomycin.

UNIT-IV
1. Hygiene and safety in fermentation industries.
3. Microbial production of Interferon, Insulin, flavours and fragrances.

UNIT-V
1. Microbial production of vaccines.
3. Microbial transformations: Steroid biotransformation
4. Intellectual property rights (IPR) and protection (IPP)
Reference Books:

2. Biotechnology - A Text Book of Industrial Microbiology by Cruger.
3. Fermentation Biotechnology: Industrial Perspectives by Chand.
MB: 304 ENVIRONMENTAL MICROBIOLOGY

UNIT-I
1. Microbial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2. Microbial interactions: competition, commensalism, parasitism, mutualism, commensalisms, synergism.
3. Population ecology: characteristics of population, population growth curves (r and k selection) population regulation.

UNIT-II
1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi, pollens and viruses.
4. Air borne diseases and their prevention.

UNIT-III
2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
3. Bioleaching; introduction, application of bacterial leaching leaching techniques, properties of bioleaching.
4. Microbial degradation of xenobiotics, petroleum and oil spilles in environmental decay behaviours and degradative plasmid.

UNIT-IV
2. Water purity test and indicator organisms, method used in environmental studies – BOD, COD, DO.
UNIT-V

2. Bioremediation of contaminations.
3. Extremophiles – acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms: physiology, morphology, biochemistry of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books

2. Environmental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi
3. Environmental Science, Physical Principles and applications; Egbert Boeker et. al.
6. Environmental Biotechnology Theory and Application by Gareth M. Evans and Judith C. Furlong, John Wiley and Sons, LTD, U.S.A.
7. Ecology and Environment by P.D. Sharma, Rastogi Publications, New Delhi, India
MB: 305 Lab course I (MEDICAL AND PHARMACEUTICAL MICROBIOLOGY and RECOMBINANT DNA TECHNOLOGIES)

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.

2. To perform various biochemical tests (IMVC, oxidase, catalase, urea utilization test, sugar utilization and H2S production on TSI agar slant) used for identification of medically important bacteria.

3. To perform sugar fermentation tests used for identification of medically important bacteria.

4. Preparation of transport media for different clinical samples.

5. Demonstration normal microbial flora of skin, mouth and throat

6. Isolation and identification of Staphylococcal species using suitable media, staining techniques and biochemical tests.

7. Isolation and identification of Staphylococcal species using suitable media, staining techniques and biochemical tests.

8. Identification of bacterial species belonging to Enterobacteriacea family using suitable biochemical tests (E.coli, Proteus, Pseudomonas, Klebsiella)

9. Isolation and identification of enteric fever causing bacteria (Salmoella typhi) using suitable media and biochemical tests.

10. Isolation and identification of Bacillus species using suitable media, staining techniques and biochemical tests.

11. Microbiological analysis of urine specimens.

12. Microbiological analysis of sputum specimens

13. Isolation dermatophytes and their identification based on colony morphology and microscopic characteristics.

14. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method

15. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
16. To study antibiotic resistance in bacteria
17. Preparation of LB broth, LB Agar with antibiotic for culture and maintenance of Host
   *E.coli* and *E.coli* with plasmid vector
18. Isolation of plasmid DNA (or plasmid vector DNA)
19. Restriction digestion of given DNA with suitable restriction enzymes.
20. Ligation of insert (gene) and vector DNA
21. Preparation of competent cells
22. Transformation of host *E.coli* with recombinant DNA and selection of recombinants.
23. To perform PCR for amplification of target DNA segment (or gene)
MB: 306 Lab course II (FERMENTATION AND MICROBIAL TECHNOLOGY & ENVIRONMENTAL MICROBIOLOGY)

1. Determination of thermal death point (TDP) of an Organism
2. Determination of thermal death time (TDT) of an Organism
3. Isolation of amylase producing microorganisms from Soil
4. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
5. Isolation of lipase producing microorganisms from butter.
6. To isolate antibiotic producing microorganisms from soil
7. To isolate Penicillium species producing penicillin.
8. Production of penicillin and to evaluate its activity
9. To demonstrate handling and sterilization of Fermentor
10. Production of wine from grapes
11. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.
12. Determination of Total Dissolved Solids (TDS) of given water sample
13. Determination of chemical oxygen demand (COD) of given water sample
14. Determination of Dissolved oxygen (DO) of given water sample
15. Determination of BOD of given water sample
16. Determination of total bacterial population by standard plate count technique
17. Determination of the most probable number (MPN) of coliform bacteria in water
18. Microbiological analysis of water by membrane filter method
19. Microbiological analysis of air for presence of pathogenic microorganisms in air
20. Microbiological analysis of water for presence of pathogenic microorganisms
MB: 401 AGRICULTURAL MICROBIOLOGY

UNIT I
1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.

UNIT II
1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.
3. Bacterial diseases of plants: Citrus canker, blight of rice
4. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady’s finger

UNIT III
1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests: Bacillus thuringiensis as bacterial insecticide
3. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)
4. Fungal control of insect pests: Entomopathogenic fungi: Metarhinium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni

UNIT IV
1. Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects
2. Mycotoxins and their effect on human being.
3. General idea about quarantine
4. Production of biogas and alcohol from agricultural wastes
UNIT V

1. Biofertilizers: Types, production and application
2. Mycorrhizae: Types and their application in agriculture and forestry.
3. Vermicomposting
4. Reclamation of waste agricultural land by microorganisms

Reference Books

MB: 402 FOOD MICROBIOLOGY

UNIT I
1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and desiccation.
3. Chemical preservatives and additives.

UNIT II
1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

UNIT III
1. Classification of food borne diseases.
2. Food borne infections: Brucella, Bacillus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella spp.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (Clostridium Botulinum).
4. Food adulteration and prevailing food standards in India.

UNIT IV
1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test ).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms: Butter, yoghurt and cheese.
UNIT V
1. Microorganisms as source of food : Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions : Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food : Sample collection, preparation and analysis techniques

Reference Books:
MB: 403 Lab course (FOOD MICROBIOLOGY AND AGRICULTURE MICROBIOLOGY)

1. Detection of adulterants in spices, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products
3. Detection of arsenic by microbiological methods
4. Detection of nicotinic acid by bioassay
5. Detection of number of bacteria in milk by SPC
6. Determination of quality of milk sample by methylene blue reductase test.
7. To demonstrate role of yeast in bread-making
8. Isolation of spoilage microorganisms from food
9. Isolation of pathogenic microorganisms from food
10. To study viral diseases in plants
11. To study bacterial and fungal diseases in plants
12. Isolation of rhizobia from root nodules of leguminous plants
15. To study pesticidal activity of Bacillus thuringiensis.
16. Isolation of VAM spores from soil
17. Isolation of Azotobacter species from soil
18. Isolation of microorganisms from rhizosphere,

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