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<th>Paper No.</th>
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<th>Periods/Week</th>
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• Out of 100 Theory and 100 Practical Marks for each paper, 15 marks for internal assessment and 85 marks for semester-end examinations.
• Out of 85 Marks of each practical examination, 15 marks should be allotted for viva-voce and 10 marks for Record.
I SEMESTER

MB 101: GENERAL MICROBIOLOGY

UNIT – I:


UNIT- II:

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods, chemical methods and their application. Concept of containment facility, sterilization at industrial level.

Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development.

Microscopic identification characteristics, staining methods – simple staining, differential staining, structural staining and special staining methods

Microbiological media-Natural and synthetic; autotrophic, heterotrophic and phototropic media: basal, defined, complex, enrichment, selective, differential, maintenance and transport media

Preservation and Maintenance of Microbial cultures: Repeated sub culturing, preservation at low temperature, sterile soil preservation, mineral oil preservation, deep freezing and liquid nitrogen preservation, drying, glycerol cultures, freeze-drying (lyophilization). Advantages and disadvantages of each method.

UNIT -III:

Morphology, Ultra structure and chemical composition of bacteria, actinomycetes, spirochetes, rickettsiae, mycoplasma, Chlamydiae – TRIC agents and LGV Archaebacteria

UNIT- IV:

Eukaryotic microorganisms: General characteristics, reproduction and economic importance of fungi. Classification, structure, composition, reproduction and other characteristics of fungal divisions-Zygomycota, Ascomycota, Basidomycota, Deuteromycota and slime & water molds

Structure, reproduction and other characteristics of algal divisions. Distribution of algae. Characteristics of – blue green algae, dinoflagellates, thallus organization, products of algae and their economic importance. Algal SCP, emphasis on Spirulina


RECOMMENDED BOOKS FOR MB 101:

1. Bergey’s Manual of Systematic Bacteriology (9th edition) volumes I to VI
2. Methods for General and Molecular Bacteriology (2nd edition) by GERHARDT (Editor–in-Chief)
3. Microbiology (5th edition) PELCZAR, CHAN & KRIEG.
4. Brock Biology of Microorganism (9th edition) by MADIGAN, MARTINKO & PARKER.
5. Introduction to Microbiology by ROSS.
6. Basic Microbiology by VOLK & WHEELER.
7. Fundamental Principles of Bacteriology by SALLE.
8. General Microbiology by Stainier, Deudroff and Adelberg
10. Introduction to Algae by Morris, I.
12. Fresh water algae of the United States by Smith, GM.
13. Introductory Mycology, by Alexopolus, C.J.
14. Dispersal in Fungi by Ingold, CT.
17. Fundamentals of Microbiology by D.E. Alcamo, Jones and Bartlett, Boston.

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MB 102: VIROLOGY

UNIT–I:


Nomenclature, classification and structure of viruses – criteria used for naming, classification of viruses, recent ICTV classification of viruses infecting animals, humans, plants, bacteria, algae, fungi. Major characteristics of different virus families/genera/groups- Poxviridae, Hepadnaviridae, Baculoviridae, Adenoviridae, Herpesviridae, Ortho and Paramyxoviridae, Retroviridae, Reoviridae, Parvoviridae, Rhabdoviridae, Picornaviridae, Flaviviridae, Potyviridae, Tobamoviridae, Bromoviridae, Bunyaviridae, Geminiviridae, Caulimoviridae.

Algal, Fungal and Bacterial viruses- Phycodnaviridae, Cyanophages, Partitiviridae and Totiviridae. Subviral agents-sat viruses, Sat nucleic acids, Viroids, Prions.
UNIT-II:

Properties of Viruses- Biological properties of viruses – host range, transmission-vector, non-vector; Physical properties of viruses – morphology, structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical characteristics – chemical composition of viruses, proteins, nucleic acids, envelope, enzymes, lipids, carbohydrates, polyamines, cations, Antigenic nature of viruses.

Isolation, cultivation, assay and maintenances of viruses – Animal, Plant and Bacterial Viruses: biassay tissue culture – organ culture, primary and secondary cell cultures, suspension and monolayer cell cultures, cell strains, cell lines, embryonated eggs; experimental plant tissue cultures.

UNIT – III:

Viral replication and genome expression – viral genomes- structure and complexity of viral genomes, diversity among viral genomes – DNA and RNA genomes-linear, circular, double and single stranded; positive and negative sense of RNA genomes, mono, bi tri and multipartite of genomes. Replication of viruses – an overview of viral replication cycles, replication strategies of DNA, RNA viruses and regulation of viral genome expression- Baltimore strategies.

Virus – host interactions – cytopathic effects of viral infections, inclusion bodies, chromosomal aberrations; Response of host cells to viral infection –interference, immunological responses of the host,

UNIT – IV:


Diagnosis of viral diseases – chemical symptoms, immuno diagnosis, molecular methods used in viral diagnosis, prevation and control of viruses: prevation – sanitation, vector control, vaccines and immunization control – chemophrophylaxis, chemotherapy – anti viral drugs, interferon therapy, efficacy of infection control.

REFERENCE BOOKS FOR MB 102:


5. Basic Virology, 1999, by Waginer and Hewelett, Black Well Science Publ


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MB 103: BIOMOLECULES

UNIT – I:


UNIT – II:

secondary, tertiary and quaternary, denaturation of proteins. Hydrolysis of proteins. Protein sequencing using various methods.

**UNIT – III:**

Nucleic acids – structure, function and their properties. Structural polymorphism of DNA, RNA. Structural characteristics of RNA.


**UNIT-IV:**

Biological oxidation, Biological redox carriers, biological membranes, electron transport, oxidative phosphorylation and mechanism. Bacterial photosynthesis, photosynthetic electron transport


**RECOMMENDED BOOKS FOR MB 103:**

1. Biochemistry (2nd edition) by VOET & VOET.
2. Outlines of Biochemistry (5th edition) CONN, STUMPF, BRUENING & DOI.
3. Biochemistry (3rd edition) by STRYER.
4. Biochemistry by ZUBAY.
5. Principles of Biochemistry by LEHNINGER, NELSON & COX.
6. Harper’s Review of Biochemistry by MARTIN, MAYER & RODWELL
7. Principles of Biochemistry: General aspects by SMITH, HILL, LEHMAN, LEFKOWITZ, HANDLER & WHITE
8. Biochemistry of Nucleic acids by Davidson

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MB 104: ANALYTICAL TECHNIQUES

UNIT – I:
Microscopy – Principles of light, phase, fluorescent & electron microscopes; Microtomy – sectioning. Microscopic techniques: Basic principles and applications of phase – contrast microscopy (phase annulus, phase plate, specimen preparations), fluorescent microscopy (filters, dark field condensor, complex optical system, sample preparations) and electron microscopy (Magnetic lenses, electron beams, condensors, types of electron microscopy – scanning and transmission, sample preparations - fixing of specimens, preparation of blocks, microtomy and staining, negative staining techniques of biological samples), cytometry and flow cytometry.

UNIT – II:
Principles of Centrifugation – Centrifugation techniques-preparative and analytical methods, density gradient centrifugation.

General principles and applications of chromatography – Paper, Column, Thin layer, Gas, Ion exchange, Affinity chromatography, HPLC, FPLC and Gel filtration.

Electrophoresis – moving boundary, zone (Paper Gel) electrophoresis. Immunoelectrophoresis. Immunoblotting. Isoelectric focusing, 2-D electrophoresis

UNIT – III:

UNIT-IV:

Manometric techniques. Freeze drying and its application in biological systems.

RECOMMENDED BOOKS FOR MB 104:
1. Instrumental Methods of Chemical Analysis by CHATWAL & ANANAD.
2. Practical Biochemistry: Principles and techniques by WILSON & WALKER.
3. Physical Biochemistry: Application to Biochemistry and Molecular biology (2nd edition) by FREIFELDER.
4. Biochemical methods (2nd edition) by SADASIVAM & MANICKAM.
5. Biophysical Chemistry: Principles and techniques by UPADHYAY, UPADHYAY & NATH.
6. HAWK’S Physiological Chemistry by OSER.
7. Modern Experimental Biochemistry, by R.F.Boyer, Benjamin Cummings Publ. Company
8. Manometric and Biochemical Techniques by Umbtict, Burris and Staffer, Burgross.

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MBP 105: MICROBIOLOGICAL METHODS & VIROLOGY

1. Isolation methods – Pour plate, Streak plate and Dilution methods.
3. Detection of motility by hanging drop method,
4. Selective and indicator media – Crystal violet blood agar, Potassium tellurite blood agar, Neomycin blood agar, Salt nutrient agar, Mannitol salt agar, Phenolphthalein phosphate nutrient agar and Aesculin bile medium.
6. Growth curves, Bacterial growth measurement, viable count by spread plate method, colony count. Enumeration by dry weight and turbidometric methods,
7. Culturing of anaerobic microorganisms
8. Metabolic (Biochemical) tests – Catalase and Oxidase tests. Indole reaction. Methyl red and Voges-Proskauer reactions, citrate utilization, starch and gelatin hydrolysis; H₂S production.
10. Isolation of phage from soil, Cultivation and preservation of phages, Quantitation of phages
11. Growth phages of phage and burst size
12. Cultivation of animal viruses by different routes in embryonated chicken/duck eggs Yolksac, Allantoic and Chorio allantoic membrane (CAM) routes.
13. Animal cell culture-Sheep kidney cell culture, chicken embryo fibroblast cell culture
14. Mechanical inoculation of plant viruses – Tobacco mosaic virus or cucumber mosaic virus and graft transmission of plant viruses.
15. Measurement of size of spores and cells.
16. Isolation and culturing of fungi (yeasts and molds) and algae
17. Observation of specimen and permanent slides

RECOMMENDED BOOKS FOR MBP 105:
1. Microbiology: A laboratory manual by CAPPUCCINO & SHERMAN
2. Laboratory Experiments in Microbiology by Gopal Reddy, M.N.Reddy, D.V.R. Sai Gopal and K.V.Mallaiah,
4. Laboratory Exercises in Organismal and Molecular Microbiology by S.K. Alexander, D.Strete and M.J. Mily, Mc. Graw Hill, USA.
13. Laboratory Exercises in Microbiology by Chan, Mc. Graw Hill, U.S.A.

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MBP 106: ANALYTICAL TECHNIQUES

1. Qualitative tests of carbohydrates, lipids, amino acids, proteins & nucleic acids.
2. Estimation of reducing sugar-Anthrone method
3. Estimation of sugar by titration method – Benedict’s method
5. Determination of pKa and pl values of amino acids.
6. Quantitation of glycine by formol titration
7. Paper Chromatography of amino acids, sugars, and purine and pyrimidine bases.
8. Colorimetric determination of any one amino acid.
9. Separation of pigments by adsorption chromatography
10. Thin Layer chromatography separation – sugars & lipids
11. Molecular weight determination of enzymes / proteins by Gel filtration, SDS-PAGE.
12. Determination of saponification value of fats
13. Determination of iodine number of oils
14. Determination of acid value of fats
15. Demonstration of GM counter.
16. Determination of molar absorption coefficient of amino acid/protein and estimation of its concentration

RECOMMENDED BOOKS FOR MBP 106:
II SEMESTER

MB 201: MICROBIAL PHYSIOLOGY & METABOLISM

UNIT– I:


Growth phases of bacteria –survival of microbial cells. Importance of each growth phase. Synchronous cultures – methods of synchronous culturing

Continuous culturing methods, factors effecting growth. Methods of growth measurement. Physiology and biochemistry of sporulation and germination of spores

UNIT-II:

mechanisms of lactic acid, ethanol, butanol and citric acid fermentations. Nitrate and sulphate respiration.

UNIT-III:

Metabolism of amino acids –Biosynthesis of amino acids and their regulation with emphasis on tryptophan and histidine by microorganisms


UNIT –IV:

Lipid metabolism - Biosynthesis of triacyl glycerols, phospholipids and sphingolipids.

Oxidation of saturated and unsaturated fatty acids. Microbial metabolism of aromatic and aliphatic hydrocarbons (camphor, 2,4-D and toluene) with emphasis on the role of monooxygenase and dioxygenase in the ring cleavage (ortho, meta and gentisate cleavage) and reductive catabolism.

Nucleotide metabolism - Biosynthesis of purine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides. Regulation of nucleotide synthesis, catabolism of purine and pyrimidines.

Secondary metabolism - Utilization of secondary metabolites for production of vitamins, toxins (aflatoxin and corynebacterial), hormones (GA), and antibiotics (penicillin and streptomycin).

RECOMMENDED BOOKS FOR MB 201:

1. Microbial physiology by Moat and Foster.
2. An introduction to bacterial physiology by Price and Stevens.
3. An introduction to bacterial physiology by Oginsky and Umbreit.
5. Growth of bacterial cell by Ingraham, Lod and Neichardt.
6. Microbial energetic by Dawes.
11. Textbook of Microbiology by M.Burrows.
12. Microbial physiology and Metabolism by D.R.Caldwell, Wm.C.Brown Publ.
15. Molecular Cell Biology by Lodish et al.
16. General Microbiology by Stainer, Macmillan educational Ltd.
22. Biochemistry of Nucleic acids by Davidson.
23. Biological chemistry by Mullar and Cords.
25. Bacterial metabolism by Dwelley.

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UNIT-I:

UNIT-II:
Signal transduction in eukaryotes: Protein kinases, phosphorylation cascades, Ras pathway, MAP kinase pathway, etc. Cyclic nucleotides, G proteins. Mechanisms of protein translocation across membranes in prokaryotes and eukaryotes, coated vesicles, membrane receptors.

UNIT-III:
Outlines of enzyme classification, nomenclature, assay of enzymes and kinetics of enzyme catalyzed reactions – Michaelis – Menton equation, determination of Kₘ, Vₘₐₓ and kₖₐₜ values. Factors affecting enzyme reaction – pH, temperature, radiation, enzyme and substrate concentrations, activators, coenzymes and metalloenzymes. Ribozymes and abzymes

UNIT-IV:

RECOMMENDED BOOKS FOR MB 202:
1. Cell and Molecular Biology by E.B.P. De Robertis, Lippincott Williams & Wilkins.
5. Biochemistry by Lehninger.
10. Enzymes by Dixon and Webb.
12. The Chemical reactions of Living Cells, Vol 1 and 2, by Metzler

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**MB 203: MOLECULAR & MICROBIAL GENETICS**

**UNIT-I:**

**UNIT-II:**

**UNIT-III:**
Mutations – Terminology, types of mutations, Molecular basis of mutations, isolation & analysis of mutants. Mutagenesis – base analogue mutagens, chemical mutagens, intercalating substances, mutator genes. Site directed mutagenesis, mutational hot spots, Reversion, second site revertants, frame shift mutations, carcinogens, screening of mutants. UV damage of DNA and repair.

UNIT-IV:

RECOMMENDED BOOKS FOR MB 203:
1. Cell and Molecular Biology by E.B.P. De Robertis, Lippincott Williams & Wilkins.
5. Genes – VII by Benjamin Lewen.
8. Genetics by Gardener.
13. Bacterial and Bacteriophage genetics by E.A. Birge Springer.
UNIT-I:

History and scope of limnology cells involved in immune system – T-lymphocytes, B- lymphocytes, monocytes, macrophages, APC, Neutrophils, mast cells. Types of immunity - Adaptive immunity, innate immunity. lymphoid organs, Thymus, bone marrow, spleen, lymph nodes. Antigen-Antibody reactions - Ag-Ab binding, agglutination, blood groups, immunoflourescence, and important immunological diagnostic tests - ELISA, RIA, immuno blot, Immunodiffusion, Immunoelectrophoresis, Complement fixation test (CFT).

UNIT-II:

Nature of antigens; antibody structure, classification of antibodies, functions of IgG, IgA, IgM, IgD and IgE; primary and secondary immune response; serological analysis of antibodies – isotypes, allotypes and idiotypes. Antibody diversity, antigen receptors on B and T lymphocytes. Phagocytosis, opsination, Opsonins and polyclonal and (monoclonal antibody production) (Hybridoma techniques) – Applications of monoclonal antibodies in biomedical research, clinical diagnosis and treatment. The complement system - components of classical and alternative complement pathways, complement receptors, biological, consequences of complement activation.

UNIT-III:

UNIT-IV:

RECOMMENDED BOOKS FOR MB 204:
1. Immunology and Immunopathology by Stewart.
2. Cellular and Molecular Immunology by Abul K. Abbas et al.
3. Textbook of Immunology by Barret.
7. Immunology – An introduction by Tizard.
8. Text book of Immunology by Unani and Benacerraf
10. Immunology – A short course by Benjaini, Sunshine and Lesrowitz.
11. Basic and Clinical Immunology by Stites, Terr and Parslow.
12. Immunology by Herman N. Eosen.
13. Molecular Basis of Immunology by Constantin Bena.
   Wm.C.Brown Publishers.
17. Viruses that affect Immune system by H.Y.Fan, I.S.Y.Chen, N. Rosenberg and
   W. Sugden, American society for Microbiology

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**MBP 205: ENZYMOLOGY AND IMMUNOLOGY**

1) Assay of microbial enzymes (any two) – Amylase, protease, catalase, urease
   and pectinase.
2) Production, isolation, purification and assay of any one of the above enzymes
3) Enzyme Kinetics: (any one of the above enzymes):
   a) Effect of substrate and enzyme concentration on enzyme activity;
      Determination of $K_M$ and $V_{max}$ values.
   b) Effect of pH, temperature and inhibitors on enzyme activity.
4) Enzyme and Whole cell immobilization.
5) Separation of Serum - Immunoelectrophoresis.
6) Ouchterlony double diffusion.
7) Radial immunodiffusion.
8) Immunoprecipitation and precipitin curve.
9) ELISA.
10) Western blotting.
11) Agglutination inhibition test.
12) Blood grouping, Rh typing, VDRL, WIDAL
13) Complementation test in bacteria.
14) Bacterial conjugation

15) Raising antiserum.

RECOMMENDED BOOKS FOR MBP 205:

1. Practical Immunology by Hudson and Hay.
2. Antibodies: A Laboratory manual by Harlow and Lane.
3. Manual of Clinical Immunology by Rose and Friedman.
4. Immunochemistry in Practice by Johnstone and Thrope.
6. An Introduction to Practical Biochemistry by Plummer.

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MBP 206: MICROBIAL PHYSIOLOGY AND GENETICS

2. Estimation of DNA by Diphenyl amine method.
3. Estimation of RNA by Orcinol method
5. Estimation of Ammonical nitrogen and nitrates.
6. Strain improvement using chemical mutagens.
7. Isolation of mutants using EMS.
8. UV Survival curve of E.coli. or any other bacteria.
9. Study of the repair mechanism for the damage caused by UV radiation.
11. Protoplast preparation and regeneration.
12. Observation of mitosis in Onion root tips.
13. Observation of meiosis in Flower buds.

RECOMMENDED BOOKS FOR MBP 206:

1. A short course in bacterial genetics – A laboratory manual and Handbook for Eschericia coli and related Bacteria – Jeffrey H Miller, Cold spring Harbor Laboratory press

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II SEMESTER

NON-CORE PAPER: MB 207: PRINCIPLES OF MICROBIOLOGY

UNIT-I - SCOPE AND HISTORY OF MICROBIOLOGY

UNIT-II - INFECTIOUS DISEASES OF HUMAN ORGAN SYSTEMS

UNIT-III - ANTIMICROBIAL THEROPY AND BASIC PRINCIPLES OF IMMUNOLOGY

UNIT-IV - MEDICAL MICROBIOLOGY
III SEMESTER

MB 301: MOLECULAR BIOLOGY

UNIT-I:
Proof of DNA & RNA as genetic material; Transformation experiments, Blenders experiments, properties of genetic material. Modern concept of gene structure. Overlapping genes, split genes, constitutive genes, jumping genes, Oncogenes. Types of tumors, physical, chemical and biological Carcinogens, chromosomal changes induced by Carcinogens.

UNIT-II:

UNIT-III:
The genetic code: Deciphering the genetic code; theory of triplet code, elucidation of base composition of codons. Identification of stop and start codons, universality of the code, redundancy of the code, the decoding system. Protein synthesis: Mechanism and role of various factors involved in Initiation, elongation and termination of Protein Synthesis Inhibitors of protein synthesis. Post translational processing of proteins, protein channeling, role of RNA in protein synthesis.

Unit-4:
Regulation of gene expression at the levels of transcription and translation. Operon concept; Regulatory genes, structural genes and repressors. Negative and Positive regulation. Regulation of lac, ara and trp operons. Catabolite repression. Regulation of gene expression in lambda and nif operon. Regulation of gene expression in eucaryotes.

RECOMMENDED BOOKS FOR MB 301:


10. A Passion for DNA Genes, Genomes and Society by James D Watson, CSHL Press.

11. Cell and Molecular Biology by Cooper, ASM Press.

12. Molecular Biology by Friefelder.

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**MB 302: MEDICAL MICROBIOLOGY**

**UNIT-I:**


**UNIT-II:**

Description and pathology of diseases caused by Aspergillus, Penicillium, Mucomycosis, Blastomycosis, Microsporosis, Rhinosporidium, Epidermophyscosis. Description and pathology of diseases caused by hemoflagellates; *Leishmania donavani, L.tropica, Trypanosoma gambiense*; intestinal flagellates; Trichomonas, Giardia, *Entamoeba histolytica*, malarial parasites, Helminthes; *Ascaris lumbricoides*, Hook worm, pinworm, Filarial parasites.
UNIT-III:


UNIT-IV:

Viral diseases: Description, pathology and lab diagnosis of diseases caused by pox viruses; herpes virus (chicken pox- zoster); orthomyxo and paramyxio viruses; adenovirus, other respiratory viruses, (Influenza, Rhyno) viruses affecting nervous system (ex: Polio virus, Rabies virus), enterovirus, reovirus, viral hepatitis, HIV. Interferon – Nomenclature, types & classification, Induction of interferon, types of inducers.

RECOMMENDED BOOKS FOR MB 302:

4. Medical Microbiology by Melnick.
12. Medical Microbiology – A Clinical perspective by J.B.Sharma, paras publishing.
14. Medical Microbiology by Jawetz.
MB 303: BIOSTATISTICS & BIOINFORMATICS

UNIT-I:


UNIT-II:


UNIT-III:


UNIT-IV


RECOMMENDED BOOKS FOR MB 303:

2. Biological sequence analysis by Durbin, Eddy, Krogh, Mithison

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MB 304: MOLECULAR BIOTECHNOLOGY

UNIT-I:

r-DNA technology- Isolation of nucleic acids, DNA sequencing, maxam-Gilbert and Di-deoxy methods. Restriction endonucleases, restriction maps, Southern, Northern blotting and western blotting. DNA finger printing, PCR- principle, types, application.

UNIT-II:


UNIT-III

Gene expression- expression of cloned genes in bacteria, yeast, plant and animal cells. Application of recombinant DNA technology in biology, plant, medicine,
genetic diseases, gene therapy. Genetically engineered microorganisms and intellectual property rights.

UNIT-IV

Nucleic acid probe technology, DNA micro array – printing of oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expression using fluorescent-labelled c-DNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips. Protein micro array, advantages and disadvantages of DNA and protein micro arrays.

RECOMMENDED BOOKS FOR MB 304:
3. Molecular Cell Biology by Lodish et al.
6. Recombinant DNA by J.D. Watson et al.
8. Recombinant DNA & Biotechnology by H. Krenzer.
9. DNA micro arrays by M.Schena.
10. Molecular Biology by David & Freifelder.
12. Immobilized cells: Principles and Applications by Tampion & Tampion.
5. Transformation and Induction of β-galactosidase in *E.coli*
6. Bacteriophage titration – Plaque forming Units (PFU)
7. Polymerase Chain Reaction (PCR).
8. Recovery of DNA from gels – Electro elution and extraction of DNA from low melting gels.

**RECOMMENDED BOOKS FOR MB 305:**

3. Genome analysis, 2000, 4 volumes, ESHE Press.

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**MBP 306: MEDICAL MICROBIOLOGY AND BIOINFORMATICS**

1. Preparation of different media used in diagnostics Microbiology.
2. Laboratory examination of sputum: collection of sputum. Microbiological examination of sputum for pus cells and predominant bacteria. Ziehl-Neelson staining to detect AFB culturing the specimen.
3. Collection of throat swabs – culturing the specimen.
4. Laboratory examination of pus and skin specimens for *staphylococcus aureus*, *streptococcus pyogenes* and *Pseudomonas aeruginosa*.
5. Examination of urine for pathogenic microorganisms – collection of urine, microscopic examination of urine, comparison of normal specimen with urinary tract infection sample. The Enterobacteriaceae – *Escherichia coli*, *Klebsiella pneumonia* and *proteus mirabilis*. Urine cultures, single colonies, seeding in peptone water and Christensen’s urea medium. Examination of blood agar, nutrient agar and Mac conkey plate cultures.
7. Medical Parasitology – E. histolytica, G. lamblia, Trypanosomas, Leishmania and Plasmodium (Permanent Slide Observation)
8. Laboratory diagnosis of common helminthes infections (permanent slide observations of helminthes)
9. Serological Tests: Hemoglobin estimation, RBC Count, WBC Count, Bleeding time, Clotting tie, Erythrocyte Sedimentation Rate (ESR), Packed Cell Volume (PCV)

RECOMMENDED BOOKS FOR MB 306:
1. Practical Medical Microbiology by Mackie.
2. Practical Medical Microbiology Vol-II by Cruichshank et al.
5. Laboratory Manual in Microbiology by Alcamo.

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III- SEMESTER

NON-CORE PAPER: MB 307: APPLIED MICROBIOLOGY

UNIT-I - MOLECULAR BIOLOGY


UNIT- II - FERMENTATION TECHNOLOGY

An introduction to fermentation processes – the range of fermentation processes – Types of fermentors, Microbial growth kinetics, batch culture, continuous culture, fed batch culture and dual or multiple fermentations. Production of ethyl alcohol. Microbial leaching – role of microorganisms in the recovery of minerals (uranium, copper) from ores.

UNIT – III - ENVIRONMENTAL MICROBIOLOGY

**UNIT – IV - FOOD AND AGRICULTURAL MICROBIOLOGY**


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**IV SEMESTER**

**MB 401: FERMENTATION TECHNOLOGY & INDUSTRIAL MICROBIOLOGY**

**UNIT-I:**

An introduction to fermentation processes – the range of fermentation processes. Microorganisms used in industrial microbiological processes – the isolation, preservation and strain improvement of industrially important microorganisms, screening methods, isolation of autotrophic mutants. Media and materials required for industrial microbiological processes – Antifoams.

**UNIT-II:**

Microbial growth kinetics, batch culture, continuous culture, fed batch culture and Dual or multiple fermentations. Inoculum development for large-scale processes. Design of fermentor: Construction and maintenance of aseptic conditions. Control of various parameters. Sterilization of media. Types of fermentors. Computer application

**UNIT-III:**

Production of ethyl alcohol, beer & wine. Enzyme probe biosensors, biochips, biofilms, biosurfactants, Biotransformation, Petroleum Microbiology. Microbial leaching-role of microorganisms in the recovery of minerals (uranium, copper) from ores.

**UNIT-IV:**

Microbial products from genetically modified (cloned) organisms ex: insulin. Microbial groups involved in biogas production, design of digester.

Patenting: Concept and its composition & protection of right and their limitation, intellectual property rights (IPR); patenting biotechnology inventions.

**RECOMMENDED BOOKS FOR MB 401:**

2. Industrial Microbiology by Waiter.
3. Fermentation Microbiology and Biotechnology by Mansi.
4. Industrial Microbiology by Patel.
5. Biotechnology: A text book of Industrial Microbiology by Greger
7. Industrial Microbiology by Prescott & Dunn.
10. Industrial Microbiology by B.M. Miller & W. Litsky.
11. Economic Microbiology by Rose, Vol-I to V.
12. Advances in Applied Microbiology by Ed Perlman, Series of volumes.

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UNIT-I:
Basic concepts of Ecology and Environment – Biological spectrum at levels of organization & realm of ecology. Ecosystem – Concept, components, food chains, food webs and tropic levels. Energy transfer efficiencies between tropic levels. Biological factors influencing the growth and survival of microorganisms- inter reactions of microbial population and community dynamics – Growth in closed environments and in open environments. The kinetic properties of competition between microbial populations. Kinetic principles of prey-predator relationship.

UNIT-II:
Aquatic environment: Fresh water microorganisms, their zonation and characteristics. Salt water, oceans, estuaries, microorganism their zonation and characteristics. Faecal pollution of waters – water borne diseases, indicator organisms. IMVIC test, sanitary examination of water.

UNIT-III:
Microorganisms and pollution: Microbial production of methyl mercury, trimethyl arsenic, hydrogen sulphide, acid rain water, carbon monoxide, ammonia, nitrate, nitrogen oxides, nitrosamines, Eutrophication, algal toxins.
Microorganisms and sewage treatment: COD, BOD & DO, trickling filters, activated sludge process, oxidation ponds; sludge treatment (anaerobic digestion).

UNIT-IV:
Bioremediation Technology – Microbial degradation of oil spills, pesticides and detergents, Biofouling; Fate of genetically engineered microorganisms in the environment. Environmental impact assessment studies.
Deterioration of materials – paper, textiles, painted surfaces, prevention of microbial deterioration.

RECOMMENDED BOOKS FOR MB 402:
7. Bioremediation principles by Eweis.
8. Techniques in Microbial Ecology by Buruage.

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MB 403: FOOD MICROBIOLOGY & AGRICULTURAL MICROBIOLOGY

UNIT-I:
Microbiology of foods – Microbial flora of fresh foods, grains, fruits, vegetables, milk, meat, eggs and fish and their infestation by bacteria, fungi and viruses. Microbiological examination of foods- microscopic techniques and cultural techniques. Direct microscopic examination, total colony counts and differential enumeration. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Microbial spoilage of milk, food, types of spoilage organisms, food poisoning, mycotoxins and bacterial toxins.

UNIT-II:
Food processing & preservation: Methods of food preservation, Aseptic handling, pasteurization of milk, refrigeration and freezing, dehydration, osmotic pressure, chemicals – organic acids, nitrates, nitrites and cresols; Radiation – UV light, Y-irradiation. Fermented foods – preparation of Yogurt, streptococcus species, Lactobacillus bulgaricus; Manufacture of cheese; Pencillium roqueforti. Fermented soybean products.
Microorganisms as food – single cell protein, yeast, algae and fungal biomass production.

**UNIT-III:**

Soil Environment- Microorganisms, soil structure, soil profile, Physico-chemical conditions, Microbial composition, sampling techniques, role of Microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins)


**UNIT-IV:**

Biofertilizers – Introduction, biofertilizers using nitrogen fixing microbes – phosphate solubilization- Rhizobium, Azatobacter, Azospirillum, Azolla; Anabaena Symbiosis, blue green algae, Mycorrhiza, Biopesticides – toxins from Bacillus thuringiensis, Psuedomonas syringae, Biological Control – Use of Baculovirus, NPV virus, protozoa & fungi in biological control.

**RECOMMENDED BOOKS FOR MB 403:**

5. Basic Food Microbiology by Banwart, GJ (1989), CBS Publishers and Distributors, Delhi
7. Agricultural Microbiology by G.Rangaswamy and Bagyaraj, Prentice Hall India.
UNIT-I:
Chemical disinfectants, antiseptics and preservatives. Types of Antibiotics-B-lactam antibiotics, tetracycline group Rifamycin, aminoglycoside antibiotics, macrolides, polypeptide antibiotics, glycopeptide antibiotics, miscellaneous antibacterial antibiotics and antifungal antibiotics. Production of antibiotics – Penicillin, Streptomycin, Erythromycin, bacitracin and tetracycline.

UNIT-II:

UNIT-III:
Industrial Production of Enzymes – amylases, Proteases, organic acids- lactic acid, citric acid, vinegar, aminoacids – L-lysine, L-glutamic acid; Food supplements and hormones. Production of Vitamin B_{12}; Microbial transformation of sterioids and nonsteroids. Analytical Microbiology – microbiological assays of Vitamins (Riboflavin, B_{12}), amino acids (lysine, tryptophan).

UNIT-IV:
Ecology of Microorganisms as it effects the pharmaceutical industry; Microbial spoilage & preservation of medicines using antimicrobial agents; quality assurance and the control of microbial risk in medicines. Contamination of non-sterile pharmaceuticals in hospital & community environments.

RECOMMENDED BOOKS FOR MB 404:
3. Topics in Antibiotic chemistry Vol I to V Sammes Ellis Horwood.

 MBP 405: INDUSTRIAL MICROBIOLOGY & ENVIRONMENTAL MICROBIOLOGY
1. Production of citric acid by A.niger. Recovery & Fermentation.
2. Estimation of Ethanol by dichromate method.
3. Production of Ethanol by fermentation and recovery.
4. Preparation of Wine from grapes by fermentation.
5. Production of glutamic acid by fermentation.
7. Observation of air-borne microflora by petriplate exposure.
8. Effect of pesticides on pure cultures of bacteria.
9. DO Estimation.
10. BOD Estimation.
11. COD Estimation

RECOMMENDED BOOKS FOR MB 405:
3. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production technology by Aneja.
7. Environmental Microbiology: A Laboratory manual by Peppler, Gerba & Bredecks.

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**MBP 406: FOOD, AGRICULTURAL & PHARMACEUTICAL MICROBIOLOGY**

1. Microbiological examination of milk & milk products.
2. Preparation of Yoghurt
3. Microbiological examination of fresh & canned foods.
4. Microbiological quality testing of milk (MBRT test)
5. Isolation of yeasts from grapes.
6. Culturing of Mushrooms.
7. Isolation of Rhizobium from root nodules.
8. Isolation of Azotobacter from soil.
10. Microbiological Assay of Vitamin B_{12}.

**RECOMMENDED BOOKS FOR MB 406:**

1. Handbook of Milk Microbiology by Srivastava.
2. Laboratory methods in Food Microbiology by W.F. Harrigan.
4. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom production technology by Aneja.

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