FIRST YEAR – Semester- I

**MBT- 101 Introductory Microbiology, Microbial Techniques And Biology Of Microorganisms**

**TOTAL HOURS: 48** **CREDITS: 4**

**UNIT-I History** No. of hours: **8**

History and mile stones in Microbiology – Meaning, definition and history of Microbiology. Contributions of Antony von Leeuwenhoek, Edward Jenner, Louis Psteur, Robert Koch, Iwanowsky, Beijerinck, Winogradsky and Alexander Fleminf, Importance and applications of Microbiology. Virology – Basics of virology, history, milestones, taxonomy and significance of virology.

**UNIT – II Classification, general characters of eukaryotic Microorganisms, Isolation and Staining Techniques** No. of hours: 10

Classification of microorganisms – Heckel's three Kingdom concept - Whittaker's five kingdom concept and three domain concept of Carl Woese and phylogenetic tree. Basis of modern microbial classification and their concepts, nomenclature and taxonomic ranks. General characters of Fungi (Yeasts, Candida) – Algae (Cyanobacteria, Chlorella), Protozoa (Entameoba, Leishmania, Plasmodium). Isolation and identification of Microorganisms – Principles and types of stains (Simple, Differential and negative stains), structural stains – spore, capsule, flagella. Hanging-drop method.

**UNIT-III Sterilization** No. of hours: **8**

Sterilization and disinfection techniques - Principles and methods of sterilization, Physical methods – autoclave, hot- air oven, pressure cooker, laminar air flow, filter steilzation, Radiation methods – UV rays. Gamma rays. Ultrasonic methods. Chemical methods. Chemical methods – Use of alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites. Phenol coefficient.

**UNIT-IV Isolation & Preservation** No. of hours: 8

Pure culture techiques – enrichment culturing, dilution-plating, streak-plate, spread-plate and micromanipulator. Preservation of microbial cultures – subculturing, overlaying cultures with mineral oils, lyophilization sand cultures, storage at low temperature (ultra low temperature).

**UNIT –V Clasiification and general characters of prokaryotes and viruses** No. of hours: 14

Defferentiation of prokaryotes and eukaryotes. General characteristics of bacteria, archaea, rickettsias, mycoplasmas, cyanobacteria and actinomycetes. Outline classification for bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology (up to order level). Ultra structure of a bacterial cell: invariant conponents – cell wall, cell membranes, robosomes, nucleoid. Variant components – Capsule, flagella, fimbriae, endospore and storage granules, General characteristics and classification of viruses- animal, plant and microbial. Morphology, structure and replication of TMV, HIV, and lambda bacteriophage. Eukaryotes – General characteristics and classification (up to te order level) of eukaryotic microorganisms – microprotozoa, microalgae, molds and yeasts.

**MBP- 101 Introductory Microbiology, Microbial Techniques And Biology Of Microorganisms**

**TOTAL HOURS: 48** **CREDITS: 2**

1. Microbiology Good Laboratory Practices and Biosafety.

2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.

3. Preparation of culture media for cultivation of bacteria, fungi

4. Sterilization of medium using Autoclave

5. Sterilization of glassware using Hot Air Oven

6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility

7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.

8. Isolation of single colonies on solid media.
9. Isolation of pure cultures of bacteria by streaking method.
10. Preservation of bacterial cultures by various techniques.
11. Diagramatic or Electron photomicrographic observation of TMV, HIV, T4 phage and adenovirus

## SUGGESTED READING

Ram Reddy, S. and Reddy, S.M. (2007). **Essentials of Virology**. Scientific Publishers India, Jodhpur.

Reddy, S.M. (2003). **University Microbiology .I** . Galgotia Publications New Delhi.

Dube, R.C. and Maheswari, D.K. (2000) **General Microbiology**. S Chand ,New Delhi.
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**Microbiology: Principles and Explorations**, John Wiley, USA.Voet, D. and Voet, J.G. (1995) **Biochemistry**, Wiley, New York

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Singh, R.P. (2007). **General Microbiology**. Kalyani Publishers, New Delhi.

Talaro, K. and Talaro, A. (1996). **Foundations in Microbiology**. 2nd Edition. UMC Brown Publications.

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Wilson, K. and Walker, J. (1994). **Practical Biochemistry**. 4 th Edition, Cambridge University Press, England.

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Dubey, R.C. and Maheswari, D.K. (2002). **Practical Microbiology.** S. Chand & Co. Ltd., New Delhi.

Plummer, D.T. (1988). **An Introduction to Practical Biochemistry**. 3rd Edition, Tata Mc GrawHill, New Delhi.

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B.Sc MICROBIOLOGY (CBCS) SYLLABUS
FIRST YEAR – Semester- II
MBT- 201 MICROSCOPY, MICROBIAL BIOCHEMISTRY & METABOLISM

**TOTAL HOURS: 48** **CREDITS: 4**

**UNIT-I Microscopy** No. of hours: 6

Principles of microscopy - bright field, dark field,- 3 h, phase-contrast, fluorescence and electron microscopy (SEM and TEM). Ocular and stage micrometers - Size determination of microorganisms.

**UNIT-II Biomolecules** No. of hours: 12

Biomolecules of microorganisms. Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides). General characteristics of amino acids and proteins. Structure of nitrogenous bases, nucleotides, nucleic acids. Fatty acids (saturated and unsaturated) and lipids (spingolipds, sterols and phospholipids).

**UNIT-III pH, Buffers, Analytical techniques and enzymes** No. of hours: 10

Hydrogen ion concentration in biological fluids, pH measurement. Types of buffers and their use in biological reactions. Principle and applications of colorimerty and chromatography (paper, thin-layer and column). Spectrophotometric techniques (UV & visible).
Enzymes properties and classification. Enzyme unit and Biocatalysis induced fit, and lock and key model coenzymes. Cofactors. Factors affecting catalytic activity. Inhibition of enzyme activity competitive, noncompetitive, uncompetitive and allosteric.

**UNIT-IV Microbial nutrition and Growth** No. of hours: 10

Microbial nutrition –nutritional requirements and uptake of nutrients by cells.Nutritional groups of microcroorganisms- autotrophs, heterotrophs, mixotrophs, methylotrophs. Growth media synthetic, nonsynthetic, 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, turbiodometry, biomass.

**UNIT-V Intermediary Metabolism** No. of hours: 10

Aerobic respiration -Glycolysis, HMP path way, ED path way. TCA cycle. Electron transport, oxidative and substrate level phosphorylation. Anaplerotic reactions -2h. β-Oxidation of fatty acids. Glyoxylate cycle. Anaerobic respiration (nitrate, sulphate respiration). Fermentation - Common microbial fermentations with special reference to alcohol and lactic acid fermentations. Photosynthetic apparatus in prokaryotes. Outlines of oxygenic and anoxygenic photosynthesis in bacteria.

**MBP- 201 MICROSCOPY, MICROBIAL BIOCHEMISTRY & METABOLISM**
**TOTAL HOURS: 48 CREDITS: 2**

1. Light compound microscope and its handling.
2. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram .ve bacilli), cyanobacteria (*Nostoc, Spirulina*), algae (*Scenedesmus*sp., diatoms), and fungi (*Saccharomyces, Rhizopus, Aspergillus, Penicillium, Fusarium*).
3. Calibrations of microscopic measurements (Ocular, stage micrometers).
4. Measuring dimensions of fungal spores
5. Simple staining
6. Negative staining
7. Gram's staining
8. Colorimetric estimation DNA by diphenylamine method
9. Colorimetric estimation of proteins by Biuret/Lowry method
10. Paper chromatographic separation of sugars and amino acids
11. Preparation of different media: synthetic media BG-11, Complex media- Nutrient agar, McConkey agar, EMB agar.
12. Enrichment culturing and isolation of phototrophs and chemoautotrophs.

13 Setting and observation of Winogradsky column.
14 Estimation of CFU count by spread plate method/pour plate method.
15 Bacterial growth curve.
16. Factors affecting bacterial growth – pH, temperature, salts

## SUGGESTED READING


Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). **Microbiology.** 5th Edition, WCB Mc GrawHill, New York.

Madigan, M.T., Martinkl, J.M. and Parker, J. (2010). **Brock Biology of Microorganisms**, 9th Edition, MacMillan Press, England.

Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). **General Microbiology**, 5th Ed.,Prentice Hall of India Pvt. Ltd., New Delhi.

Gottschalk, G. (1986). **Bacterial Metabolism**, SpringerVerlag, NewYork.

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Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). **Principles of Biochemistry**, 2 nd Edition, CBS Publishers and Distributors, New Delhi.

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Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

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Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

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Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,

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B.Sc MICROBIOLOGY (CBCS) SYLLABUS
SECOND YEAR – Semester- III
MBT- 301 MICROBIAL GENETICS AND MOLECULARBIOLOGY

**TOTAL HOURS:48** **CREDITS: 4**

**Unit-I Nucleic acids and DNA replication** No. of hours: 10

DNA and RNA as genetic materials. Structure and organization of prokaryotic DNA Extrachromosomal genetic elements – Plasmids and transposons. Replication of DNA - Semiconservative mechanism, molecular details of DNA synthesis, enzymes involved in replication. Differences between prokaryotic & eukaryotic DNA replication.

**Unit-II**

**Mutations And DNA Damage & Gene transfer mechanisms in bacteria** No. of hours: 10

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions. Various physical and chemical mutagens. Outlines of DNA damage and repair mechanisms. Brief account on horizontal gene transfer among bacteria – transformation, transduction and conjugation.

**Unit-III GENE CONCEPT** No. of hours: **8**

Concept of gene – Muton, recon and cistron. One gene one enzyme, one gene one polypeptide, one gene one product hypothesis. Types of RNA and their functions. Outlines of RNA biosynthesis in prokaryotes. Genetic code. Structure of ribosomes.

**Unit-IV Protein synthesis** No. of hours: 12

Protein synthesis in prokaryotes and eukaryotes – Transcription, transcriptional processing and translation and termination. Types of genes – structural, constitutive, regulator.

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

**Unit-V Genetic Engineering** No. of hours: **8**

Basic principles of genetic engineering. Rrestriction 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 MOLECULARBIOLOGY**
**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 (A260 measurement)
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.

## SUGGESTED READING


Verma, P.S. and Agarwal, V.K. (2004). **Cell Biology, Genetics, Molecular Biology, Evolution and Ecology.** S. Chand & Co. Ltd., New Delhi.

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Crueger, W. and Crueger, A. (2000). **Biotechnology: A Text Book of Industrial Microbiology,** PrenticeHall of India Pvt. Ltd., New Delhi.

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B.Sc MICROBIOLOGY (CBCS) SYLLABUS
SECOND YEAR – Semester- IV
MBT- 401 MEDICAL MICROBIOLOGY & IMMUNOLOGY

**TOTAL HOURS: 48** **CREDITS: 4**

**Unit-I History of Immunology Organs and cells of Immune System** No. of hours: 10

Development of immunology. Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity. Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes. Cells of immune system. Identiification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils.

**Unit-II Antigens & Antibodies and hypersensitivity** No. of hours: 10

Antigens – types, chemical nature, antigenic determinants, haptens. Factors affecting antigenicity. Antibodies – basic structure, types, properties and functions of immunoglobulins. Components of complement and activation of complement. Types of antigen-antibody reactions-agglutinations,precipitation,neutralization,complement

fixation, complement fixation, blood groups. Labeled antibody based techniques – ELISA, RIA and Immunofluroscence. Polyclonal and monoclonal antibodies – production and applications. Concept of hypersensitivity and Autoimmunity.

**Unit-III Clinical Microbiology** No. of hours: 10

History of medical microbiology. Normalflora of human body, Defenition of infection, non specific defense mechanisms, mechanical barriers, antagonism of indigenous flora. Antibacterial substances- lysozyme, complement, properdin, antiviral substances, phagocytosis, General principles of diagnostic microbiology- Collection, transport and processing of clinical samples. General methods of laboratory diagnosis-cultural, biochemical, serological, and molecular methods.

**Unit-IV Chemotherapy and vaccines** No. of hours: **8**

Antiviral agents-Interferon and base analogues. Host - pathogen interactions, Bacterial toxins, virulence and attenuation. Elements of chemotherapy – therapeutic drugs. Drug resistance. Mode of action of penicillin and sulpha drugs, and their clinical use. Tests for antimicrobial susceptibility.

Preventive control of diseases – active and passive immunization. Vaccines – natural and recombinant.

**UNIT V Microbial diseases** No. of hours: 10

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

Air-borne diseases - Tuberculosis, Influenza

Food and water-borne diseases - Typhoid, Hepatitis- A

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

Insect-borne diseases – Malaria.

Contact diseases – Syphilis.

Zoonotic diseases – Rabies.

Blood-borne diseases –AIDS.

General account of nosocomial infections.

MBP- 401 MEDICAL MICROBIOLOGY & IMMUNOLOGY

**TOTAL HOURS: 48** **CREDITS: 2**

1. Identification of human blood groups.
2. Estimation of blood haemoglobin.

3. Perform Total Leukocyte Count of the given blood sample.

4. Perform Differential Leukocyte Count of the given blood sample.

5. Separate serum from the blood sample (demonstration).

6. Perform immunodiffusion by Ouchterlony method.

7. Identify bacteria (any three of *E. coli, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests

8. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar)

9. Study of bacterial flora of skin by swab method

10. Perform antibacterial sensitivity by Kirby-Bauer method

11. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)

12. Study of various stages of malarial parasite in RBCs using permanent mounts.

**SUGGESTED READING**


1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier

4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

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6. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.

7. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

8. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – Semester- V

MBT- 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

**TOTAL HOURS: 36** **CREDITS: 3**

UNIT - I **Microorganisms and their Habitats** No. of hours: **8**

Microorganisms of environment (soil, water and air). soil microflora, Aeromicroflora and dispersal of microbes. Microflora of fresh water and marine habitats. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Role of microorganisms in nutrient cycling (nitrogen, sulphur). Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

UNIT – II **Water Potability** No. of hours: **8**

Microbiology of potable and polluted waters. 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 and (c) Presence/absence tests.

Outlines of biodegradation of environmental pollutants – pesticides.

UNIT – III **Waste Management** No. of hours: **6**

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 Soil Microbiology and PGPR** No. of hours: **7**

Biotic and abiotic components of soil, soil profile. Rhizosphere and phyllosphere

Plant Growth Promoting Microorganisms(PGPR) -mycorrhizae, rhizobia, *Azospirillum, Azotobacter,* cyanobacteria, *Frankia* and phosphate-solubilizing microorganisms. Outlines of biological nitrogen fixation (symbiotic, non-symbiotic). Biofertilizers - *Rhizobium*.

**Unit – V Concept of Disease And Microbial pesticides** No. of hours: **7**

Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases caused by fungi (groundnut rust), bacteria (angular leaf spot of cotton) and viruses (tomato leaf curl Principles of plant disease control. Biological control of plant diseases. Biopesticides – *Bacillus thuringiensis,* Nuclear polyhedrosis virus (NPV), *Trichoderma*.

MBP- 501 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

**TOTAL HOURS: 36** **CREDITS: 2**

1. Study of soil flora isolation - qualitative & quantitative (bacteria, fungi and actinomycetes)
2. Enrichment/ isolation of – starch hydrolysers.
3. Study of air flora by petriplate exposure mrthod.
4. Analysis of potable water: SPC, Presumptive, confirmed and completed test, determination of coliform count in water by MPN, Membrane filtration techniq ue.
5. Waste water analysis: Biological Oxygen Demand(BOD).
6. Isolation and enumeration of major groups of microorganisms from rhizospere and nonrhizosphere soil.
**7.** Study of root nodules and Isolation of *Rhizobium*
*8.* Isolation of *Azotobacter*
9. Staining and observation of Vesicular Arbuscular Mycorrhizal (VAM) fungi.
10. Isolation of plant diseases of local importance- Rusts, Smuts, Powdery mildews, Tikka disease of groundnut, Citrus canker, Bhendi yellow vein mosaic, Tomato leaf curl. Little leaf of Brinjal

**SUGGESTED READINGS**


1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.

11.Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.

12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – Semister- VIa

MBT- 601 MICROBIAL DIAGNOSIS IN HEALTH CLINICS

**TOTAL HOURS: 36** **CREDITS: 3**

**Unit 1 Importance of Diagnosis of Diseases** No. of hours: **8**

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

**Unit 2 Collection of Clinical Samples** No. of hours: **8**

How to collect 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 3 Direct Microscopic Examination and Culture.** 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 4: Serological and Molecular Methods** No. of hours: 6

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes.

Typhoid, Dengue and HIV, Swine flu

**Unit 5: Testing for Antibiotic Sensitivity in Bacteria** 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

**TOTAL HOURS: 36** **CREDITS: 2**

1. Collection & transport of clinical specimens (Blood CSF Urine, Stool, Bone marrow, Sputum, Swabs,
   Aspiration fluid etc)., Receipts, Labeling, recording and dispatching clinical specimens.,
2. Collection transport and processing of various clinical specimens , i.e. blood, CSF urine swabs faeces, etc. For microbiological diagnosis.,Investigation of various common epidemics , Gastroenteritis, Cholera, Food poisoning, Meningitis , Encephalitis, P.U.O., Study of nosocomial infection.
3. Isolation of bacteria in pure culture and Antibiotic sensitivity.
4. Identification of common bacteria by studying their morphology, cultural character, Biochemical reactions, slide agglutination and other tests.
5. Maintenance and preservation of stock culture.

**SUGGESTED READING**

1. Ananthanarayan R and Paniker CKJ (2009)Textbook of Microbiology, 8th edition, Universities Press Private Ltd.

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication

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

4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby

5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – Semester- VIb
MBT- 601 MICROBIAL BIOTECHNOLOGY

**TOTAL HOURS:36** **CREDITS: 3**

**Unit 1 Microbial Biotechnology and its Applications** **No. of Hours: 8**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast

**Unit 2 Therapeutic and Industrial Biotechnology** **No. of Hours: 7**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors

**Unit 3 Applications of Microbes in Biotransformations Products and their Recovery**

**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. Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization

**Unit 4**

**Microbes for Bio-energy and Environment** **No. of Hours: 7**

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents

**Unit 5 RNAi and Intellectual Property Rights** **No. of Hours: 4**

RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen

Interactions Patents, Copyrights, Trademarks

MBP- 601 MICROBIAL BIOTECHNOLOGY

**TOTAL HOURS: 36** **CREDITS: 2**

1. Study yeast cell immobilization in calcium alginate gels
2. Study 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**

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.

2. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
3. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.
4. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
5. Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
6. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press

7. Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
9. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS

THIRD YEAR – Semester- VII

MBT- 701 FOOD AND INDUSTRIAL MICROBIOLOGY

**TOTAL HOURS: 36** **CREDITS: 3**

**UNIT- I Food Microbiology – I** No. of hours: 7

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

**UNIT – II Food Microbiology – II** No. of hours: 7

General account of food preservation. Microbiological production of fermented foods – bread, cheese, yogurt. Biochemical activities of microbes in milk. Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw). Concept of probiotics and neutraceuticals

**UNIT – III Industrial Microbiology – I** No. of hours: 7

Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes. Screening and isolation of industrially-important microorganisms. Outlines of strain improvement.

**UNIT – IV Industrial Microbiology – II** No. of hours: 6

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

Design of a stirred tank reactor fermentor. Fermentation media

**UNIT – V Industrial Microbiology – III** No. of hours: 9

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

MBP- 701 FOOD AND INDUSTRIAL MICROBIOLOGY

**TOTAL HOURS: 36** **CREDITS:2**

1. Observation of different spoiled food
2. Isolation of bacteria and fungi from spoilt bread/fruits/vegetables
3. Preparation of Yogurt/Dahi
4. Determination of the microbiological quality of milk sample by MBRT
5. Isolation of antagonistic microorganisms by crowded plate technique
6. Microbial fermentation for the production and estimation of ethanol
7. Microbial fermentation for the production and estimation of citric acid

# SUGGESTED READING


1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi

2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishing Company Ltd. New Delhi, India

3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education

4. Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's Microbiology.9th Edition. McGraw Hill Higher education

5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

6. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

7. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

8. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

9. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

10. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India

B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – Semester- VIIIa
MBT- 801 MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

**TOTAL HOURS: 36** **CREDITS: 3**

**Unit 1 Microbiological Laboratory and Safe Practices No. of Hours: 10**

Good laboratory practices - Good microbiological practices. Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3. Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

**Unit 2 Determining Microbes in Food / Pharmaceutical Samples 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 3 Molecular methods of diagnosis No. of Hours: 4**

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

**Unit 4 Pathogenic Microorganisms of Importance in Food & Water No. of Hours: 10**

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 5 HACCP for Food Safety and Microbial Standards 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 CREDITS: 2

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

**SUGGESTED READING**


1. Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press

2. Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.

3. Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer

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

5. Microbiology - A laboratory manual, Cappuccino & Sherman , 6 th Ed, Pearson Education
6. Manual of diagnostic microbiology, Dr.B.J.Wadher & Dr.G.L.Bhoosreddy, First .Ed ., Himalaya publishing house, Nagpur.
7. Pharmaceutical Microbiology – W.B. Hugo
8. Pharmaceutical Microbiology – Purohit
9. Laboratory Exercises in Microbiology, George.A.Wistreich & Max.D.Lechtman, 3 rd Ed, Glencoe press, London.

B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – Semister- VIIIb
MBT- 801 BIOFERTILIZERS AND BIOPESTICIDES

**TOTAL HOURS: 36** **CREDITS:3**

**Unit 1 Biofertilizers** **No of Hours: 10**

General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N2 fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

*Frankia* - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis. Cyanobacteria, *Azolla* - Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

**Unit 2 Non - Symbiotic Nitrogen Fixers** **No of Hours: 6**

Free living *Azospirillum*, *Azotobacter* - free isolation, characteristics, mass inoculums, production and field application.

**Unit 3 Phosphate Solubilizers** **No of Hours: 6**

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

**Unit 4 Mycorrhizal Biofertilizers** **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 5 Bioinsecticides** **No of Hours: 7**

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, *Bacillus thuringiensis*, production, Field applications, Viruses – cultivation and field applications.

## MBP- 801 BIOFERTILIZERS AND BIOPESTICIDES

**TOTAL HOURS: 36** **CREDITS: 2**

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.

2. Isolation of microbes (bacteria & fungi) from soil (28ºC & 45ºC ).

3. Isolation of phosphate solubilizers from soil

3. A visit to biofertilizers production unit to see Inoculum production and field application of Rhizobium, Azospirillum/Azotobacter

**Suggested Readings**


1. Kannaiyan, S. (2003). Bioetchnology of Biofertilizers, CHIPS, Texas.

2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.

3. Reddy, S.M. et. al. (2002). Bioinoculants for sustainable agriculture and forestry, Scientific Publishers.

4. Subba Rao N.S (1995) Soil microorganisms and plant growth Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

5. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

6. Aggarwal SK (2005) Advanced Environmental Biotechnology, APH publication.

One credit consists of 16 in-class contact hours (with one contact hour equaling 50 minutes of a regular course or 100 minutes of a lab course) over a period of no less than two weeks. A regular semester (Spring: From March - June, Fall: September - December) lasts 16 weeks. A student in a single class with 3 HUFS credits will have enrolled in 48 hours of class time. A student enrolled in our recommended 12 credits per semester will have enrolled in 192 hours of time spent in class. This does not include any study work spent outside of the lecture/lab period. 1 hour of class time/week = 16 hou...Â  Total. 134/*150. My hunch is that the 48 hours is the total that would count toward the total credit hours required for a degree. A course load of additional hours beyond the 48 in oneâ€™s major would not count toward, say, 120 hours for the degree. Continue Reading. Loadingâ€¦ Originally Answered: What does "Maximum 48 credit hours in the Major subject" means? Am I limited to just take 48 credit hours in major Subject? This is a good question that you should research before selecting the school.Â  This leaves 90â€“48 = 42 hours for OTHER classes. Of course you can take more classes related to your major, but they will not count towards your 42 hours of breadth requirements. A credit is the recognition for having taken a course at school or university, used as measure if enough hours have been made for graduation. In a college or university in the United States, students generally receive credit hours based on the number of "contact hours" per week in class, for one term; better known as semester credit hours (SCH). A contact hour includes any lecture or lab time when the professor is teaching the student or coaching the student while they apply the course information to

Total debt is calculated by adding up a company's liabilities, or debts, which are categorized as short and long-term debt. Financial lenders or business leaders may look at a company's balance sheet to factor in the debt ratio to make informed decisions about future loan options.Â  Found within a company's general ledger, accounts payable represents a short-term debt that a business owes to its creditors, suppliers and others. Items in this account could include bills from credit card companies, landscaping services, office supply warehouses and more. 2. Wages payable. With employees on the payroll, businesses have a running wages payable account that includes the amount earned but not yet distributed in the form of a paycheck. Total party wipe, but at least we got chicken(tendies). permalink. embed.Â  I just want to pay off a couple credit cards and take a week off work. I'd also really like a bookcase for my apartment. I haven't been able to find one at Goodwill in the last year.Â  [â€“] Pope_Cerebus 46 points47 points48 points 3 hours ago (16 children). Move to Vanguard when this is done. They don't seem to have a max you can put it at. calculation applies: 48 - 54 hours of total student learning hours = 1 unit of credit. S Example: Integrated lab with 36 hours of in-class and 18 hours of homework for 1 unit. Calculating Units: Other Instructional Formats.Â  In these instances, committees should consider if the proposed weekly / daily hours can be reasonably achieved by a student in a short format? For example: S 3-unit ENGL 101 proposed for 2-week term. 54 in-class / 108 homework. Would be 27 hours in-class p/week and 54 hours p/week in homework. A credit is the recognition for having taken a course at school or university, used as measure if enough hours have been made for graduation. In a college or university in the United States, students generally receive credit hours based on the number of "contact hours" per week in class, for one term; better known as semester credit hours (SCH). A contact hour includes any lecture or lab time when the professor is teaching the student or coaching the student while they apply the course information to