

**B.Sc. CREDIT BASED SEMESTER SCHEME
MICROBIOLOGY (PART 2)
SCHEME OF INSTRUCTIONS AND CREDITS**

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
I SEMESTER								
MBT - 101	Basic Microbiology	T	4	3	30	70	100	2
MBT - 102	Basic Microbiology	p	3	3	15	35	50	1
							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
II SEMESTER								
MBT - 201	Microbial Taxonomy and Culture Techniques	T	4	3	30	70	100	2
MBT - 202	Microbial Taxonomy and Culture Techniques	p	3	3	15	35	50	1
							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
III SEMESTER								
MBT - 301	Microbial Physiology and Microbial Genetics	T	4	3	30	70	100	2
MBT - 302	Microbial Physiology and Microbial Genetics	p	3	3	15	35	50	1
							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
IV SEMESTER								

MBT – 401	Molecular Biology and Recombinant DNA Technology	T	4	3	30	70	100	2
MBT - 402	Molecular Biology and Recombinant DNA Technology	p	3	3	15	35	50	1
							150	3

Paper No.	Title of the paper	Type of paper	Hours / Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
V SEMESTER								
MBT – 501	Agricultural and Environmental Microbiology	T	4	3	30	70	100	2
MBT – 502	Food and Dairy Microbiology	T	4	3	30	70	100	2
MBT – 503	Agricultural and Environmental Microbiology	P	3	3	15	35	50	1
MBT - 504	Food and Dairy Microbiology	P	3	3	15	35	50	1
							300	6

Paper No.	Title of the paper	Type of paper	Hours/ Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
VI SEMESTER								
MBT – 601	Immunology and Medical Microbiology	T	4	3	30	70	100	2
MBT – 602	Industrial Microbiology and Microbial Technology	T	4	3	30	70	100	2
MBT – 603	Immunology and Medical	P	3	3	15	35	50	1

	Microbiology							
MBT - 604	Industrial Microbiology and Microbial Technology	P	3	3	15	35	50	1
							300	6

Internal assessment:

Theory : (30)

- (a) Tests – 10
- (b) Assignments - 15
- (c) Attendance - 05

Practical : (15)

- (a) Tests – 10
- (b) Class Records – 05

BANGALORE UNIVERSITY, BANGALORE
Syllabus for B.Sc Microbiology CBCS
SEMESTER I
MBT- 101 Basic Microbiology

Total hours allotted: 52

Unit 1. Introduction, History and Scope of Microbiology

10 Hours

1. Microbes and origin of life.
2. History & Scope of microbiology as a modern science.
3. Branches of Microbiology.
4. Contribution of Scientists to the field of Microbiology -Antony Von Leewenhoek, Edward Jenner, Lazaro Spallanzani, Louis Pasteur, Joseph Lister, Robert Koch, Alexander Flemming and Iwanovsky

Unit 2. Instruments used in Microbiology

8 Hours

Microscopy

1. Principles of Microscopy -resolving power, numerical aperture, working distance and magnification
2. Principles of photomicrography.
3. Working principles and applications of
 - a) Dark field microscope
 - b) Phase contrast microscope
 - c) Fluorescence Microscope
 - d) Electron Microscopy -TEM and SEM

Unit 3 Analytical Techniques

5 hours

Working principle and applications of centrifuge, Ultracentrifuge, Spectrophotometer, Chromatography(Paper & TLC).

Unit4. Stains and Staining Techniques

7 Hours

1. Nature of dyes .
2. Physical and chemical theories of staining
3. Staining Techniques -principle, procedure and applications of
 - a) Simple staining -negative staining
 - b) Differential staining -Grams and acid fast staining
 - c) Structural staining -cell wall, endospore, flagella and capsular staining

Unit 5. Sterilization Techniques

12 Hours

1. Definition of terms -sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agents and antimicrobial agent.
2. Evaluation of antimicrobial chemical agents -Tube dilution and agar plate techniques -well method and disk plate method
3. Physical methods of control -Principle, construction and application of moist heat sterilization -Boiling, Pasteurization, Fractional sterilization -Tyndallization and Moist heat under pressure -autoclave. Dry heat sterilization -Incineration and hot air oven
Filtration -Diatomaceous earth filter, seitz filter, membrane filter and laminar air flows
Radiation -Ionizing radiation - γ rays and non-ionizing radiation -UV-rays
4. Chemical methods: Alcohol, aldehydes, phenols, halogen, metallic salts, quaternary ammonium compounds and sterilizing gases as antimicrobial agents. Selection of a chemical agent for practical applications.

Unit 6. Antibiotics and other chemotherapeutic agents

10 Hours

1. Definition and classification of antibiotics.
2. Characteristics of antibiotics that qualify them as chemotherapeutic agents.
3. Mode of action of antimicrobial agents – a brief account
4. Antimicrobial spectrum of antibiotics and mode of action of the following antibiotics
 - a) **Antibacterial** -Penicillins, Cephalosporins, Bacitracin, Polymyxins, Streptomycin, Chloramphenicol, tetracyclines and Vancomycin
 - b) **Antifungal** -Nystatin and cyclohexamide
 - c) **Antiviral** -Acycloguanosine (nucleoside)
 - d) **Synthetic Chemotherapeutic agents** -Nalidixic acid
5. Development of Resistance to antibiotics -a brief account.

SEMESTER I
MBP 102 -Basic Microbiology Practical

Total hours allotted: 15

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| 1. Safety measures in Laboratory. | 1 unit |
| 2. Study of student microscope and research microscope -Construction, working principle, care to be taken while using the microscope. Use of oil immersion objective | 1 unit |
| 3. Study of instruments - Autoclave, hot air oven, Laminar air flow bench, Inoculation chamber, inoculation loop and needle, Incubator, centrifuge, pH meter, seitz filter, colony counter, membrane filter and colorimeter/spectrophotometer. | 4 units |
| 4. Cleaning and sterilization of glassware. | 2 units |
| 5. Study of aseptic techniques -preparation of cotton plugs for test tubes and pipettes, wrapping of petriplates and pipettes, transfer of media and inoculum. | 2 units |
| 6. Staining of bacteria - | |
| a) Simple staining -methylene blue staining . | |
| b) Gram staining . | |
| c) Structural staining -cell wall, endospore staining and capsule staining | 5 units |

Students have to submit of 3 bacterial slides (permanent) for the examination

References:

1. Aneja K.R., Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, New C Age International, New Delhi.
2. Atlas R.M., *Microbiology -Fundamentals and applications*, Macmillan Publishing Company, New York.
3. Benson Harold J., *Microbiological Applications*, WCB McGraw- Hill, New York.
4. Brock T .D. and Madigan M. T., *Biology of Microorganisms*, Prentice Hall of India Private Limited.
5. Narayanan P., *Essentials of Biophysics*, New Age International, New Delhi.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., *Microbiology*, WCB McGraw- Hill New York,
8. Salle A.J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
9. Stanier R. Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi,

SEMESTER II
MBP 201 -Microbial Taxonomy and Culture Techniques

Unit 1. The Microbial World -The study of various groups of microorganisms.

1. Study of viruses 10 hours
- a) Early developments of virology
 - b) General structure and properties of viruses
 - c) Virus purification and assay
 - d) Principles of Viral Taxonomy
 - e) Structure, reproduction, cultivation and significance of:
 - Bacteriophages (T 4 and lambda)
 - Plant viruses (TMV)
 - Animal viruses (HIV and Herpes virus)
 - f) Prions and Virioids -Nature and significance
2. Comparison of the three domains of organisms: Bacteria, Archaea, Eucarya (tabular and diagrammatic) 2 hours
3. Study of Bacteria :
- a) Size, shape and arrangement of bacterial cells
 - b) Fine structure;"composition and function of Eubacterial cell wall, cell membrane, cytoplasm, nucleoid, flagella, pili, fimbriae, slime layer, capsule, spores and cysts
 - c) Classification of Bacteria- Brief account of major characteristics used in bacterial classification. 10 hours
- 4.a. Classification, Morphology, Cultivation, Reproduction and significance of:
- i] Rickettsia
 - ii] Chlamydia
 - iii] Mycoplasma
 - iv] Actinomycetes
- b. General characteristics, classification, cell structure and reproduction of Cyanobacteria (type study of *Anabaena* and *Spirulina*), Parallelism between bacteria and cyanobacteria.
- c. Brief account of Archaea
- d. Fungi- ultrastructure of fungal cell, Salient features, classification, reproduction and significance of major groups of fungi (Phycomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes). Type study of *Rhizopus*, *Aspergillus*, *Penicillium*, Yeast, *Agaricus* and *Fusarium*.
- e. Protozoa -General features, classification and significance. 21 hours

Unit 2. Culturing of microorganisms

- 1. Culture media -Synthetic and non-synthetic -solid, liquid and semi-solid media, Special Media -Enriched, selective, transport, differential, maintenance and enrichment media.
- 2. Methods of isolation of bacteria, fungi -Serial dilution, pour plate, spread plate and streak plate.
- 3. Maintenance of pure cultures.
- 4. Cultivation of anaerobic bacteria -Anaerobic jar method. 7 hours

Unit 3. Microbial growth

- 1. Nutritional requirements of microorganisms -Macronutrients, micronutrients and growth factors. Nutritional types of microorganisms: Autotrophs and heterotrophs, phototrophs and chemotrophs.
- 2. Physical factors affecting growth of microorganisms: Temperature, pH and Oxygen.
- 3. Multiplication in bacteria -binary fission, budding and fragmentation.
- 4. Bacterial growth curve, synchronous growth.
- 5. Continuous cultivation -chemostat and turbidostat
- 6. Counting of bacteria -Viable count -SPC, Total count -DMC and turbidimetric estimation. 10 hours

SEMESTER II
MBP202 -Microbial Taxonomy and culture techniques practical

Total units allotted: 15

- 1 Preparation of Media -Nutrient broth, Nutrient Agar, Martin's Rose Bengal medium, Sabouraud's Agar.
2 units
2. Isolation of Bacteria and Fungi from soil
- a) Preparation of serial dilutions. 2 units
- b) Spread plate and pour plate techniques.
- c) **Streaking techniques** for isolation and purification of bacteria.
- d) Study of colony characteristics of bacteria
- e) Identification of bacteria and fungi.
3. Motility of bacteria by hanging drop technique. 1 unit
4. **Measurement of size of cells by micrometry.** 2 units
5. Counting of yeast cells and fungal spores using Haemocytometer. 2 units
6. Study of fungi -Identification of fungi by tease-mount method using Lactophenol cotton blue
1 unit
7. Type study of *Aspergillus*, *Penicillium*, Yeast, *Rhizopus* and *Fusarium* (Specimens)
2 units
8. Demonstration of slide culture technique of fungi. 2 units
9. Study of protozoa -*Amoeba*, *Paramecium* and *Euglena*. (Permanent slides)
10. Study of **Blue-green algae -Anabaena and Spirulina. (Specimens)** 1 unit
- Students have to submit of **two fungal and one Blue-green algae slide** (permanent) for the examination.

References:

1. Alexopoulos C.J. and Mims C.W., *Introductory Mycology*, New Age International, New Delhi.
2. Aneja K.R., *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*, New Age International, New Delhi. .
3. Atlas R.M., *Microbiology -Fundamentals and applications*, Macmillan Publishing Company, New York.
4. Benson Harold J., *Microbiological Applications*, WCB McGraw- Hill New York.
5. Bold H.C. and Wynne M.J., *Introduction to Algae*, Prentice Hall of India Private Limited, New Delhi.
6. Brock T.D. and Madigan M.T., *Biology of Microorganisms*, Prentice Hall of India Private Limited.
7. Mehrotra R.S. and Aneja K.R., *An Introduction to Mycology*, New Age International, New Delhi.
8. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.
9. Prescott Lansing M., Harley John P. and Klein Donald A., *Microbiology*, WCB McGraw- Hill New York.
10. Salle A,J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
11. Stanier R. Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.

SEMESTER III
MBP 301 - Microbial Physiology and Microbial Genetics

Total hours allotted: 60

Unit 1. Microbial Physiology

1. Biomolecules -A brief account of the properties, classification and importance of carbohydrates, lipids and proteins. 4 Hours
2. Enzymes -Introduction, properties, nomenclature and classification, Mechanism of enzyme action, effect of various factors influencing enzyme activity, enzyme inhibition. enzyme regulation and ribozymes. 6 Hours
3. Bioenergetics -Free energy. ATP and its production, other high energy compounds. 4 Hours
4. Oxidation-reduction reactions. 1 Hour
5. Energy yielding processes -Breakdown of carbohydrates -Glycolytic pathways -EMP, HMP shunt, pentose phosphate pathway and ED; TCA; ETS and oxidative phosphorylation, anaerobic respiration, chemoautotrophy -oxidation of inorganic compounds -N, S, Fe and H. 12 Hours
6. Fermentation -Fermentative modes in microorganisms -alcoholic, Lactic acid -hetero afd homo, acetic acid. propionic acid, butyric acid. mixed acid and butanediol fermentation. 6 Hours
7. Bacterial photosynthesis -photosynthetic pigments, photosynthetic apparatus in prokaryotes, photosynthesis in .purple and green bacteria. 4 Hours

Unit 2. Genetics

1. Genomic organization in Prokaryotes and Eukaryotes. 2 Hours
2. Nucleic acids: Chemical composition of DNA and RNA, Watson and Crick model of DNA. Types of DNA -A, B, Z and H, Super coiling of DNA 4 Hours
3. DNA replication in Prokaryotes -Semi conservative method, Rolling circle model. Origin of replication, Primers and template. Replication fork, Unidirectional and Bi-directional (8 mode) 5 Hours
4. Genetic recombination in Bacteria -Conjugation. F+ v/s F-, Hfr+ v/s F-, F' v/s F-, Transformation -Griffith's experiment and mechanism, transduction -generalized and specialized. 5 Hours
5. Molecular basis of mutations -Spontaneous and induced mutations. 4 Hours
6. Transposable elements and transposon mutagenesis, Detection and isolation of mutants - Replica plate method. 3 Hours

SEMESTER III
MBP302 Microbial Physiology and Microbial Genetics Practical

Total units allotted: 15

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|---|---------|
| 1. Determination of growth curve for <i>tungl</i> by Colony diameter method | 2 units |
| 2. Biochemical tests used for the identification of Bacteria. | |
| a) IMViC | |
| b) Fermentation of glucose, sucrose, and lactose -acid and gas production | |
| c) Mannitol motility test | |
| d) Starch hydrolysis | |
| e) Gelatin liquefaction test | |
| f) Catalase | |
| g) Oxidase test. | 8 units |
| 3. Estimation of reducing sugar glucose -by DNSA method | 1 unit |
| 4. Estimation of Protein by Lowry's method | 1 unit |
| 5. Effect of pH and temperature on bacterial growth | 2 units |
| 6. Charts on Genetic recombination in Bacteria - | |
| Conjugation -F+v/s F-, Hfr+ vis F-, F'v/s F | |
| Transformation | |
| Griffith's experiment and Qlechanism, | |
| Transduction -generalized and specialized | 1 unit |

References:

1. Freifelder David, *Microbial Genetics*, Narosa Publishing House, New Delhi.
2. Gerald Karp, *Cell Biology*, McGraw Hill Book Company, New York.
3. Moat A.G. and Foster S.W., *Microbial Physiology*, John Wiley and Sons, New York.
4. Nelson David L. and Cox Michael M., *Lehninger Principles of Biochemistry*, Macmillan Press/Worth Publishers, New Delhi
5. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.
6. Prescott Lansing M., Harley John P. and Klein Donald A., *Microbiology*, WCB McGraw-Hill, New York.
7. Salle A.J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
8. Stanier R. Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.
9. Stickberger M.W., *Genetics*, Prentice Hall of India Private Limited, New Delhi.
10. Voet D. and Voet J.G., *Biochemistry*, John Wiley and Sons, New York.

SEMESTER IV
MBP 401 - Molecular Biology, Genetic Engineering and Biophysics

Total hours allotted: 60

Unit 1. Molecular Biology

1. Types of RNA and their functions. 3 Hours
2. Protein Synthesis in Prokaryotes -Ribosomes, types of RNA involved transcription, translation, and mechanism of protein synthesis, and protein inhibitors. 5 Hours
3. Gene Structure and expression 3 Hours
4. Regulation of gene expression in prokaryotes -The operon concept, Induction and repression, The lac operon. Tryptophan operon, catabolic repression and Attenuation 5 Hours

Unit 2. Recombinant DNA technology

1. History and fundamentals of r-DNA technology 1 Hour
2. Tools for rDNA technology- DNA manipulative enzymes: Restriction enzymes, Ligases and other DNA modifying enzymes 4 Hours
3. Gene cloning vectors -Salient features, Plasmids -properties, types, pBR322 and pUC18 and pUC18 series vectors, bacteriophages λ and M13, cosmids -properties 5 Hours
4. Vectors for plants: *Agrobacterium tumefaciens* ' 1 Hour
5. Vectors for Animals: SV 40 1 Hour
6. *In vitro* construction of r-DNA molecules: Isolation of passenger DNA from bacteria (gene of interest) and isolation of vector DNA (Bacteria). 1 Hour
7. Cutting of DNA molecules -Physical methods, enzymatic methods & Joining of DNA molecules - Homopolymer tails, linkers, Adapters. 3 Hour
8. Transformation of r-DNA into target host organisms: Calcium chloride mediated gene transfer, *Agrobacterium* mediated DNA transfer, Electroporation, Microinjection, liposome fusion and Microparticle bombardment. 4 Hours
9. Screening and selection of recombinant host cells: Insertional inactivation, *In situ* colony/DNA hybridisation, and immunological techniques. 2 Hours
10. Molecular Techniques –
 - a) Electrophoresis
 - b) Blotting techniques
 - c) PCR and its applications
 - d) RFLP 5 Hours
11. Applications of Genetic Engineering
 - a) Medicine: Gene therapy 3 Hours
 - b) Agriculture: nif gene cloning
12. Potential hazards and safe guards of genetic engineering 1 Hour

Unit 3. BIOPHYSICS

1. General Introduction and scope of biophysics. 1 Hour
2. Physical methods of determining the size, shape and molecular weight of molecules -surface tension, sedimentation and viscosity. 2 Hours
3. Radioisotopes -decay units of radioactivity, biochemical and diagnostic importance of radioisotopes, dosimetry and Autoradiography. 3 Hours
4. Analytical techniques- Principle and applications of centrifuge, ultra -centrifuge, UV -Visible spectrophotometer, chromatography -Paper and TLC and X -ray crystallography. 7 Hours

SEMESTER IV
MBP 402 -Molecular Biology and Genetic Engineering practical

	<i>Total units allotted: 15</i>
1. Preparation of buffers -citrate and phosphate buffers.	1 unit
2. Estimation of DNA by Diphenylamine method.	1 unit
3. Estimation of RNA by Orcinol method.	1 unit
4. Determination of MIC of antimicrobial agents.,	2 units
5. Evaluation of antimicrobial antibiotic sensitivity tests -paper disc plate method	2 units
6. Development of antibiotic resistance in bacteria	1 unit
7. Isolation of plasmid DNA from bacteria and separation by gel electrophoresis	2 units
8. Restriction digestion of DNA	2 units
9. In vitro DNA ligation	2 units
10. Charts on genetic engineering	1 unit
a) pBR322	
b) pUC 18 and 19	
c) SV 40	
d) Bacteriophages	
e) Gene cloning	
f) Selection of recombinants by replica plate technique	

References:

1. Gerald Karp, *Cell Biology*, McGraw Hill Book Company, New York.
2. Nelson David L. and Cox Michael M, *Lehninger Principles of Biochemistry*, MacminanPress/W.orth Publishers New Delhi
3. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.
4. Prescott Lansing M., Harley John P. and Klein Donald A., *Microbiology*, WCB McGraw- Hill, New York.
5. Salle A.J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
6. Stanier R.Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.
7. Watson James D., *Recombinant DNA*, Scientific American Books, New York.

SEMESTER V
MBP 501 -Agricultural and Environmental Microbiology

Total hours allotted: 60

Unit 1. Agricultural Microbiology

1. Soil -definition, types, physical and chemical characters, soil profile; Soil microorganisms -Bacteria, fungi, actinomycetes, algae, protozoa, and viruses. 2 Hours
2. Interactions between plants and microorganisms-types of interactions (positive and negative) Microorganisms of rhizosphere, rhizoplane and phylloplane, mycorrhiza (Types and its applications). 3 Hours
3. Microbes and biogeochemical cycles -Nitrogen, sulphur, carbon and phosphorous. 2 hours
4. Bioleaching -Copper and Iron -ore form available, areas of deposits, methods of leaching, mechanism and significance. 2 Hours
5. Biodegradation -Cellulose, Pectin, plastics and pesticides. 2 Hours
6. Microorganisms in agriculture -Biochemistry, genetics and physiology of Nitrogen fixation, Symbiotic- .Rhizobium, Nonsymbiotic-*Azotobacter*, BGA and associative- *Azospirillum* associations. 5 Hours
7. Biofertilizers -Definition, Types (bacterial, fungal, Phosphate solubilizers, BGA, Plants -*Azolla*); kind of association, mode of application and merits. 2 Hours
8. Biopesticides -Introduction, types (bacterial- *Bacillus thuringiensis*, viral -NPV, fungal-*Trichoderma*), mode of action, factors influencing, genes involved and target pests. 2 Hours
9. Study of microbes as plant pathogens -*Puccinia*, *Plasmopara*, *Cercospora*, *Pyricularia*; *Xanthomonas oryzae*; Mycoplasma- Sandal spike, grassy shoot; Viruses TMV, Tomato leaf curl). 5 Hours

Environmental Microbiology

Unit 2. Microbiology of air

1. Introduction -definition, atmospheric layers, sources of microorganisms, air microflora of indoor and outdoor air, factors affecting air microflora, significance of air borne microbes, endotoxins, control and management of air borne microbes. 5 Hours
2. Techniques of trapping air borne microorganisms -gravity slide, petriplate exposure, vertical cylinder, Hirst spore trap, Rotorod sampler, Andersen sampler, Burkard trap, hand held air sampler, impingers and filtration. Advantages and disadvantages of these techniques. 5 Hours
3. Biohazards in occupational environment, allergy testing. 2 Hours

Unit 3. Microbiology of water

1. Introduction, natural waters, distribution of microorganisms in the aquatic environment, sources and types of water pollution, biological indicators of water Pollution 1 hour
2. Determination of the sanitary quality of water- N index, membrane filtration, Biological Oxygen Demand. 3 Hours
3. Water purification in municipal water supply, parameters of potable water. 2 Hours

SEMESTER V
MBP 502 -Agricultural and Environmental Microbiology practical

Total units allotted: 15

1. Isolation and enumeration of bacteria and fungi from rhizosphere and rhizoplane. 2 units
2. Study of Rhizobium from legume root nodules (gram staining) and isolation of *Rhizobium* (using Yeast Extract Mannitol Agar) and *Azotobacter* (using Ashby's Mannitol Agar) from soil. 2 units
3. Isolation of actinomycetes from soils using Glucose Aspergine Agar by plate method. 2 unit
4. Study of antagonism between soil microorganisms by plate methods- Bacteria Vs Bacteria, Bacteria vs. Fungi, Fungus vs. Fungus, Actinomycetes vs. Bacteria/Fungi. 2 units
5. Study of plant pathogens- Tikka Disease, Sandal Spike, Downy Mildew and Tomato Leaf Curl. 1 unit
6. Study of airborne microorganisms (bacteria and Fungi) in different environments by exposure plate method. , 1 unit
7. Study of air samplers- Anderson's sampler, Hirst Spore trap, Rotorod sampler and vertical cylinder 1unit
8. Determination of Biological Oxygen Demand 1unit
9. Microbial examination of water by coliform, MPN methods -for potable and sewage water:\ 2 units
10. Study of fungi -*Cladosporium*, *Helminthosporium*, *Mucor*, *Curvularia*, *Alternaria*, *Geotrichum*, *Trichoderma*. (specimens) 1unit

References:

1. Alexander M., Introduction to soil Microbiology, Wiley Eastern Limited, New Delhi
2. Alexopoulos C.J. and Mims C.W., *Introductory Mycology*, New Age International, New Delhi.
3. Aneja K.R., Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi. ...
4. Hurst, C.J., *Environmental Microbiology*, ASM Press, Washington D.C.
5. Mehrotra A.S}, *Plant Pathology*, Tata McGraw Hill Publications Limited, New Delhi
6. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., *Microbiology*, WCB McGraw- Hill, New York.
8. Salle A.J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
9. Stacey R.H. and Evans H.J., *Biological Nitrogen Fixation*, Chapman and Hall Limited, London.
10. Stanier R. Y., Ingraham J.L., *General Microbiology*, Prentice Hall of India Private Limited, New Delhi.
11. Subbarao N.S., *Soil Microorganisms and Plant Growth*, Oxford and IBH Publishing Company, New Delhi.
12. Steward W.D.P., *Nitrogen Fixation in Plants*, The Athlone Press, London.

SEMESTER V
MBP 503 -Food and Dairy Microbiology

Total hours allotted: 45

Unit 1. Food Microbiology

1. **Food and Microorganisms** -Food as a substrate for microorganisms. Sources of contamination of food
3 hours
2. **Food spoilage and food poisoning** -Spoilage of canned foods, cereals, fruits, vegetables, meat and fish.
Food sanitation and control.
Food poisoning -Endotoxin, staphylococcal poisoning, botulism and salmonellosis
Mycotoxins produced by fungi -Aflatoxin in stored food and grains
7 Hours
3. **Food preservation** -Principles of food preservation
Methods of food preservation -high temperature, canning, freezing, dehydration, chemical preservatives and radiation.
5 Hours
4. **Microbial examination of food** -DMC, viable colony count, examination of fecal streptococci
2 Hours
5. **Microorganisms as food**
Single cell proteins -yeast and *spirulina*
Single cell oils
4 hours

Unit 2. Dairy Microbiology

1. **Microorganisms and Milk**
Physical and chemical properties of milk.
Milk as a substrate for microorganisms.
Types of microorganisms in Milk -bacteria, fungi and yeast.
Sources of microbial contamination of milk -milch animal, utensils and equipment, water, milking environment,- personnel and packaging material.
8 hours
2. **Microbiological analysis of milk**
Rapid platform tests -organoleptic, Clot on boiling (COB), titratable acidity, alcohol test, DMC, sedimentation test and pH.
Standard plate count, reductase test -MBRT, Resazurin test
4 Hours
3. **Methods of preservation of milk and milk products**
Pasteurization, sterilization and dehydration
An account of condensed and dried milk
4 Hours
4. **Fermentation in milk**
Souring, lactic acid fermentation, colour and flavour fermentation, gassy fermentation and proteolysis.
3 hours
5. **Fermented Milk Products**
Yogurt -Types & production
Cheese -types and production -Cheddar & Cottage
Cultured Butter milk
4 Hours
6. **Genetic Engineering and Dairy industry**
1 Hour

SEMESTER V
MBP504 –Food and Dairy Microbiology practical

Total units allotted: 15

1. Isolation and identification of microbes from infected fruits and vegetables	2units
2. Isolation and identification of microbes from curd, idli batter, and stored foods-Jams, Jellies, Sauce and Pickles	3units
3. Bacterial examination of milk by SPC	2units
4. Bacterial examination of milk by DMC	1unit
5. MBRT	1unit
6. Estimation of Fat content in milk by Gerber's method	1unit
7. Estimation of Lactose in milk.	1unit
8. Production and detection of Aflatoxins from fungi by paper chromatography and bioassay of aflatoxins	2units
9. Study of food borne pathogens- <i>Clostridium</i> ; <i>Staphylococcus</i> , and <i>Salmonella</i> .	1unit
10. Production of yoghurt.	1unit

References:

1. Betty C. Hobbs, *Food Microbiology*, Arnold-Heinemann Publishing Private
2. Frazier and Washoff, *Food Microbiology*, Tata McGraw- Hill Publishing C
3. Hammer B. W. and Babal, *Dairy Bacteriology*, Prentice Hall Incorporated
4. Jay J.M., *Modern Food Microbiology*, CBS Publishers and Distributors, N
5. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Boo
6. Salle A.J., *Fundamental Principles of Bacteriology*, Tata McGraw- Hill Pu Delhi.
7. Varnam A.H. and Evans M.G., *Foodborne Pathogens*, Wolfe Publishing H

SEMESTER VI
MBP 601 -Immunology and Medical Microbiology

Total hours allotted: 45

Unit 1. Immunology

1. History and scope of immunology		1 Hour
2. Immunity: -Definition, types -natural, acquired, active, passive,	1 Hour	
3. Antigens -Definition, types of antigens, Factors influencing antigenicity	1 Hour	
4. Antibodies -Definition, structure types, properties and functions of Immunoglobulins. Production of Polyclonal & Monoclonal antibodies & their application.	4 Hours	
5. Antigen and Antibody Reactions -Agglutination, Precipitation, Complement fixation test, neutralization, opsonization, Gel diffusion techniques, Immuno-electrophoresis, labelled antibodies -RIA, ELISA, immunofluorescent techniques	5 Hours	
6. Complement system -properties, components, pathways and functions.		2 Hours
7. Cells, tissues and organs involved in Immune system		2 Hours
8. Immune response -CMI, MHC, AMI, immunological memory and immunological tolerance		3 Hours
9. Hypersensitivity		1 Hour
10. Immunology of tissue transplantation and cancer	1 Hour	
11. Immunohematology -Blood grouping ABO & Rh		1 Hour
12. Vaccines -definition, types		
Live attenuated vaccines -: polio and BQG.		
Killed vaccines-pertussis		
Toxoid -tetanus.		
Recombinant vaccines -hepatitis.		
DNA vaccines		
Synthetic vaccines		2 hours

Unit 2. Medical Microbiology

1. Major developments in medical microbiology.		1 Hour
2. Koch's postulates		1 Hour
3. Factors responsible for microbial pathogenicity	2 Hours	
4. Microbial flora of the human body		2 Hours
5. Important groups of pathogenic microorganisms (classification, culture, and biochemical characters, antigenic structure, pathogenicity, pathogenesis, clinical and laboratory diagnosis, epidemiology, prophylaxis and chemotherapy) of the following:		

Bacterial Diseases

- a. Gonorrhoea
- b. Diphtheria
- c. Tetanus
- d. Shigellosis
- e. Cholera
- f. Haemophilus influenza
- g. Leprosy
- h. Tuberculosis

Viral Diseases

- a. Polio
- b. Measles
- c. Mumps
- d. Rabies
- e. Hepatitis A,B
- f. HIV

Protozoan Diseases

- a. Amoebiasis
- b. Malaria

Fungal Diseases

- a. Candidiasis
- b. Cutaneous mycoses

15 hours

SEMESTER VI

MBP 602 -Immunology and Medical Microbiology practical

Total units allotted: 15

1. Isolation and identification of microorganisms from Ear, nose, throat and sputum. (Growth on Blood Agar, Chocolate agar, Braid Parker, MacConkey Agar, Nutrient Agar) 3 units
2. Isolation and identification of microorganisms from clinical samples -urine (Growth in Alkaline peptone water, Growth on Blood Agar, MacConkey Agar)
 - a) Semi quantitative estimation of cfu
 - b) Chemical analysis of urine -crystal identification, Determination of sugar and protein in urine samples
2units
3. Blood grouping 1 unit
4. Differential count of WBC. 1 unit
5. Coagulase test 1 unit
6. WIDAL test 1 unit
7. VDRL test 1 unit
8. Spot Elisa. 1 unit
9. ODD -Ouchterlony Double Diffusion 1 unit
10. RID -Radial Immune Diffusion 1 unit
11. Study of AFB –slide 1 unit
12. Study of pathogenic microorganisms -*Shigella*, *Clostridium*, *Staphylococcus*; *Streptococcus*, *Entamoeba*; *Plasmodium*, and *Candida* (Slides) 1 unit

References:

1. Abbas Abut K., Lightman Andrew K. and Pober Jordan S., *Cellular and Molecular Immunology*, W.B. , . Saunders Company, Philadelphia.
2. Anathanarayana and Paniker, *Text Book of Microbiology*, Orient and Longman, New Delhi.
3. Goldsby Richard A., Kindt Thomas J. and Osborn Barbara A., *Kuby Immunology*, W.H. Freeman and ' ' Company, New York.
4. Jawetz, Mehick, Adelberg, Brooks, Butel and Orston, *Medical Microbiology*, Prentice Hall Incorporated, London.
5. Pelczar M.J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York
6. Roitt I.M., *Essentials of Immunology*, ELBS, Blackwell scientific Publishers, London.

SEMESTER VI
MBP 603 -Industrial Microbiology and Microbial technology

Total hours allotted: 45

Unit 1 Industrial Microbiology

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| 1. History, scope and development of industrial microbiology. | 1 Hour | |
| 2. Isolation and screening of industrially important microorganisms. | 1 Hour | |
| 3. Strain improvement methods. | | 2 Hours |
| 4. Types of industrial fermentation processes: Batch, continuous, surface, submerged, and SSF | | 2 Hours |
| 5. Media components and formulation, crude media components, antifoam agents, precursors, inducers and inhibitors and buffering agents. | 5 Hours | |
| 6. Sterilization of media and raw materials and maintenance of sterility at critical points during fermentation. | | 2 Hours |
| 7. Inoculum preparation. | | 1 Hour |
| 8. Process parameters -aeration, agitation, temperature regulation, foam regulation and pH regulation. | 3 Hours. | |
| 9. Fermentor: Basic structure, construction and various types -typical stirred aerated fermentor, tower fermentor, airlift fermentor and bubble cap fermentor. | 4 Hours | |
| 10. Down-stream processing steps -Recovery of fermented broth, filtration, disintegration of cells, purification and concentration methods of byproduct, chromatographic techniques -affinity column, HPLC, ion exchange and. GLC. | 3 Hours | |

Unit 2. Microbial Technology

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|---|---------|---------|
| 1. Immobilization of enzymes and cells: | | 2 hours |
| 2. Production of chemicals -Fermentative production of
Alcohol – industrial alcohol and alcoholic beverages -beer, wine, and whiskey
Organic acids -citric acid
Vitamins-B12
Amino acid -glutamic acid
Antibiotics -penicillin
Enzymes –amylase | | 8 hours |
| 3. Biofuels: Methane and hydrogen gas production, types of substrate, process, mechanism by products, plant construction and significance | 2 hours | |
| 4. Production of vaccines -hepatitis B and hormones -human insulin | 2 Hours | |
| 5. Production and use of biofertilizers and biopesticides | 3 Hours | |
| 6. Biotransformation of steroids | | 2 Hours |
| 7. Mushroom cultivation | | 2 Hours |

SEMESTER VI
MBP 604 -Industrial Microbiology and Microbial technology practical

Total units allotted: 15

1. Production of wine from grapes	1 unit
2. Estimation of alcohol content by specific gravity method	1 unit
3. Production of Citric acid from fungi.	1 unit
4. Production and Estimation of Citric acid by Titrimetric method	2 units
5. Production and estimation of amylase from fungi	2 units
6. Production and estimation of Lactic acid in milk	2 units
7. Role of yeasts in bread making and bromothymol test	2 units
8. Mushroom Cultivation.	2 units
9. Charts on the different types of fermentors	
a) Typical stirred aerated fermentor b) Tower fermentor c) Air lift fermentor .d) Bubble cap fermentor	1 unit
10. Visit to an Industrial Microbiology / Microbial technology industry	1 unit

References:

1. Casida L.E., *Industrial Microbiology*, Wiley Eastern Limited, New Delhi.
2. Prescott S.C. and Dunn C.C., *Industrial Microbiology*, Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. Stanbury, P.F., Whitaker A. and Hall S.J., *Principles of Fermentation Technology*, Elsevier Science Limited, Aditya Books Private Limited, New Delhi.
4. Waites Michael J., Morgan Neil L., Rockey John S. and Gray Highton, *Industrial Microbiology - An introduction*, Blackwell Science. Delhi.
5. McNeil. B, and Harvey L.M., *Fermentation- A Practicat Approach*, IRL Press, New York.