SEMESTER V

MBP- 501 – Agricultural and Environmental Microbiology

PART A: Agricultural Microbiology

Total hours allotted: 40

Unit 1: Microbiology of Soil

Soil – Definition, types, physical and Chemical characters, soil profile, soil microorganisms- Bacteria, fungi, actinomycetes, algae, protozoa and viruses. 3 Hours

Interactions between plants and microorganisms – types of interactions (positive and negative) microorganisms of rhizosphere, rhizoplane and phylloplane, mycorrihza (Types and its applications)

Microbes and Biogeochemical Sciences: Nitrogen and Carbon

Bioleaching: Copper and Iron – Ore forms available, area of deposits, methods of leaching, Mechanism and Significance

Biodegradation: Cellulose, Pectin, Plastics and Pesticides

Unit 2: Agricultural Microbiology

Microorganisms in agriculture – Biochemistry, genetics and physiology of Nitrogen fixation, Symbiotic Rhizobium, Non- symbiotic – Azotobacter, BGA and associative – Azospirillum associations. 5 Hours

Biofertilizers : Defintion, Types (Bacterial, fungal, phosphate solubilizers, BGA, Plants - Azolla); kind of association mode of application and merits. 2 Hours

Biopesticides: Introduction, types (Bacterial – Bacillus thuringenesis, viral – NPV, fungal – Trichoderma), mode of action, factors influencing, genes involved and target pests. 2 Hours

Study of microbes as plant pathogens –

Fungal: Puccinia, Plasmopara, Cercospora, Bacterial: *Xanthomonas oryzae*; Mycoplasma – Sandal spike, Viruses –Tomato leaf curl 5 Hours

PART B: Environmental Microbiology

Unit 3 : Microbiology of air

Introduction – Definition, atmospheric layers, sources of microorganisms, microflora of indoor and outdoor air, factors affecting air microflora. 5Hours

Techniques of trapping air borne microorganisms and Advantages and disadvantages, Gravity slide, petri-plate exposure, vertical cylinder, Hirst spore trap, Rotorod sampler, Anderson sampler, impingers : Lemon's devices and filtration. 5 Hours

Biohazards in occupational environment, allergy testing. 2 Hours

Significance, control and Management of Airborne Microbes 1 hours

Unit 4: Microbiology of Water

Introduction: natural waters, distribution of microorganisms in the aquatic environment, Sources and types of water pollution, biological indicators of water pollution.

Determination of the sanitary quality of water-MPN index, coliform test, Membrane Filtration.

Water purification in Municipal water supply, Parameters of potable water.

SEMESTER V

MBP 502- Agricultural and Environmental Microbiology Practical

Total units allotted: 15

1. Isolation and enumeration of bacteria and fungi from rhizosphere. 2 units
2. Study of *Rhizobium* form legume root nodules (Gram staining) 1 unit
3. Isolation of actinomycetes from soil using Glucose Aspergine Agar by plate method. 2 units
4. Study of antagonism between soil microorganisms by plate methods-Bacterium Vs Bacterium, Bacterium Vs Fungus, Fungus Vs Fungus. 3 units
5. Study of plant pathogens-Tikka Disease, Sandal Spike, Downy Mildew & Tomato Leaf Curl.
6. Study of airborne microorganisms (bacteria and fungi) in different environments by exposure plate method. 2 units
7. Study of air samplers- Anderson's sampler and Rotorod sampler. 1 unit
8. Determination of Biological Oxygen Demand. 1 unit
9. Microbial examination of water by Coliform test H_2S strip test, MPN methods- for potable and sewage water. 2 units
10. Study of fungi - *Cladosporium, Helminthosporium (bipolaris), Mucor, Curvularia, Alternaria, Geotrichum and Trichoderma* (specimens). 2 units

References:

1. Alexander M., Introduction to Soil Microbiology, Wiley Eastern Limited, New Delhi.
2. Alexopoulas 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, R.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. & Klein Donald A., *Microbiology*, WCB McGraw Hill, New York.
8. Salle A.J, Fundamental Principles of Bacteriology, Tata McGraw Hill Publications Ltd, New Delhi.
9. Stacey, R.H. AND Evans, H.J., Biological Nitrogen Fixation, Chapman and Hall Limited, London.
10. Stainer R.Y.& Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, NewDelhi
11. Subbarao N.S, Soil Microorganisms & Plant Growth, Oxford and IBH Publishing Company, NewDelhi.
12. Steward, W.D.P., Nitrogen Fixation in Plants, The Athlone Press, London.

SEMESTER V

MBP 503 – Food and Dairy Microbiology

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 – Aflatoxin in stored food and grains 6 Hours
3. **Food preservation** – principles of food preservation
   Methods of food preservation – high temperature, canning, freezing, dehydration, chemical preservatives, Radiation and Bio preservation 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 spirullina
   Single cell oils – fungal lipids. 4 Hours

Unit 2. Dairy Microbiology

Microorganisms and Milk

Physical and chemical properties of milk.

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 packing material. 8 Hours

Microbial 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, Methylene blue test.* 4 Hours

Methods of preservation of milk and milk products : *Pasteurization, sterilization and dehydration.* 3 Hours

Fermentation in milk : *Sourcing, lactic acid fermentation, colour and flavor fermentation, gassy fermentation and proteolysis.* 3 Hours

Fermented milk products : *Yogurt - types & production*

Cheese – types and production – cheddar

Prebiotics and Probiotics 5 Hours

SEMESTER-V

MBP 504 – Food and Dairy Microbiology Practical

Total hours allotted: 15.

Isolation and identification of microbes from infected fruits and vegetables.	3 units
Isolation and identification of microbes from curd, idli batter.	2 units
Bacterial examination of milk by SPC	2 units
Bacterial examination of milk by DMC.	1 unit
MBRT	1 unit
Estimation of Fat content in milk by Gerber's method	1unit
Estimation of Lactose in milk.	1unit
Production and detection of Aflatoxins from fungi by paper chromatography and	2 units
Study of food borne pathogens-*Clostridium* spp., *Staphylococcus* spp., & *Salmonella* spp.	1 unit
Production of Yoghurt.	1 unit

References:

Betty C. Hobbs, *Food Microbiology*, Arnold-Heinemann Publishing Private Limited, New Delhi.

Frazier & Wasthoff, *Food Microbiology*, Tata McGraw-Hill Publishing Company Limited, New Delhi

Hammer B.W. and Babal, *Dairy Bacteriology*, Prentice Hali Incorporated, London.

Jay J.M. *Modern Food Microbiology*, CBS Publishers and Distributors, New York.

Pelczar M. J., Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw-Hill Book Company, New York.

Salle A.J. *Fundamental Principles of Bacteriology*, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Varnam A.H. and Evans M.G. *Food-borne Pathogens*, Wolfe Publishing House, London.

SEMESTER VI

MBP 601 - Immunology and Medical Microbiology

Total hours allotted : 40

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 and monoclonal antibodies and their application. 3 Hours
5. **Antigen and antibody reactions** – Agglutination (Blood grouping), Precipitation, Complement fixation test, Immunoelectrophoresis, labeled antibodies- RIA, ELISA, immune of lourescent techniques. 4 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. **Vaccines** - Definition, types
    Live attenuated vaccines - Polio and BCG
    Killed vaccines - Pertussis
    Toxoid - tetanus
    Recombinanat vaccines - hepatitis
    DNA vaccines
    Synthetic vaccines

Unit 2. Medical Microbiology

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

Bacterial diseases

a Syphilis
b Diphtheria
c Tetanus
d Typhoid
e Cholera
f Tuberculosis

Viral diseases

a. Rabies
b. Hepatitis A, B
c. HIV

Protozoan diseases

a. Amoebasis
b. Malaria

Fungal diseases

a. Candidiasis
b. Cutaneous mycoses 17 hours

MBP 602 - Immunology and Medical Microbiology Practical

Total units allotted: 15

Isolation and identification of microorganisms from Ear, nose and throat sputum.(Growth on Blood Agar, Chocolate agar, MacConkey Agar and Nutrient Agar) 3 units

Isolation and identification of microorganisms from clinical samples –urine (Growth in Alkaline peptone water, Growth on Blood Agar, MacConkey Agar.)

a) Chemical analysis of urine - crystal identification, Determination of sugar & protein in urine samples. 2 units

Blood grouping. 1 unit

Differential count of WBC. 1 unit

Coagulase test. 1 unit

WIDAL test. 1 unit

VDRL test. 1 unit

Spot Elisa. 1 unit

ODD-Ouchtlerlony Double Diffusion. 1 unit

RID-Radial Immune Diffusion. 1 unit

Study of AFB-slide. 1 unit

Study of pathogenic microorganisms - *Shigella* spp., *Clostridium* spp., *Staphylococcus*spp., *Streptococcus* spp., *Entamoeba* spp., *Plasmodium* spp. and *Candida* spp.(Slides). 1 unit

References:

Abbas Abul K. Lightman Andrew K. and Pober Jordan S., *Cellular and Molecular Immunology*, W.B. Saunders Company, Philadelphia.

Anathanarayana and Paniker, *Text Book of Microbiology*, Orient and Longman, New Delhi.

Goldby Richard A., Kindt Thomas J. and Osborne Barbara A., Kuby, *Immunology*, W.H. Freeman and Company, New York.

Jawetz Mehick, Adelberg, Brooks, Butel & Orston, *Medical Microbiology*, Prentice Hall Incorporated, London.

Pelczar M.J. Chan E.C.S. and Krieg N.R., *Microbiology*, McGraw Hill Book Company, New York.

Roitt I.M., *Essentials of Immunology*, ELBS, Blackwell Scientific Publishers, London.

Semester VI

MBP 603 – Industrial Microbiology and Microbial Technology

Total hours allotted : 40

History, scope and development of Industrial Microbiology. 1 Hour

Isolation and screening of industrially important organisms. 1 Hour

Strain improvement methods. 1 Hour

Types of industrial fermentation processes: Batch, continuous, surface, submerged & SSF. 2 Hours

Media components and formulation, crude media components, antifoam agents, precursors, inducers and inhibitors and buffering agents. 3 Hours

Sterilization of media & raw materials and maintenance of sterility at critical points during fermentation. 2 Hours

Inoculum preparation. 1 Hour

Process parameters- aeration, agitation, temperature regulation, foam regulation and pH regulation 3 Hours

Fermentor: Basic structure, construction and various types- typical stirred aerated fermentor, tower fermentor, air fliftferment or and bubblecap fermentor. 4 Hours

10. Down-stream processing steps-Recovery of fermented broth, filtration, disintegration of cells, purification and concentration methods of by product, chromatographic techniques-affinity column, HPLC, ion exchange and GLC. 4 Hours

2 Hours

Unit 2 Microbial Technology

1. Immobilization of enzymes and cells.
2. Production of chemicals: Fermentative production of:
3. Alcohol: industrial alcohol and alcoholic beverages-beer, wine and whisky
4. Organic acids: Citirc acid
5. Vitamins: B12
6. Amino acid: Glutamic acid
7. Antibiotics: Penicillin — 10 hours
8. Enzymes : Amylase
9. Biofuels: Methane and Hydrogen gas production, types of substrate, process, Mechanism, byproducts, plant construction and significance — 2 Hours
10. Production of Vaccines-Hepatitis B and Hormones-Human Insulin — 2 hours
11. Biotransformation of Steroids — 2 hours
12. Mushroom Cultivation — 2 hours

Semester VI

MBP 604 – Industrial Microbiology and Microbial Technology

Total units Alloted : 15

1. Production of wine from grapes — 2 units
2. Estimation of alcohol content by specific gravity method — 1 unit
3. Production of citric acid from fungi — 1 unit
4. Estimation of citric acid by titrimetric method — 2 unit
5. Production and estimation of amylase from fungi — 2 unit
6. Estimation of lactic acid in milk — 2 unit
7. Biogas production — 1 unit
8. Mushroom cultivation — 1 unit
9. Charts on different types of fermenters
   a) Typical stirred and aerated fermentor
   b) Tower fermentor
   c) Air lift Fermentor
   d) Bubble cap Fermentor
10. Visit to an industrial Microbiology/Microbial technology industry — 1 unit

REFRENCES

1. Casida L.E., industrial Microbiology, Wiley eastern limited, New Delhi
2. Prescott S.C. and Dunn C.C., industrial Microbiology, Tata Mc Graw-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., Rockey Jhon S and Gray Higton, industrial Microbiology-An Introduction, Blackwell Science. Delhi
5. McNeil. B and Harvey L. M., Fermentation - A Practical Approach, IRL press New York.