

**PROCEEDINGS OF THE MEETING OF B.O.S. (UG) IN MICROBIOLOGY AND BIOTECHNOLOGY**

The meeting of the B.O.S. (UG) in Microbiology and Biotechnology was held on **18<sup>th</sup> June, 2014** in the Department of Microbiology and Biotechnology, Bangalore University, Bangalore. At the outset, the Chairman welcomed the members and initiated the proceedings.

**Agenda-1**

The Credit Based Semester Scheme for B.Sc. in Microbiology and Biotechnology, the Syllabus (theory and practical) and Scheme of examination for I, II, III & IV Semesters were finalized and approved.

**Agenda-2**

The panel of examiners for UG Microbiology and Biotechnology (both external and internal) was modified and approved for the year 2014-15.

**Agenda-3**

The B.O.S. approved the list for the formation of B.O.E. (UG) in Microbiology and Biotechnology for the year 2014-15.

The meeting concluded with the Chairman thanking all the members for their co-operation.

Members present:

1. Dr. Shastri P. S
2. Dr. Jyotsna B. S
3. Dr. Bharathi
4. Smt. Pushpalatha. T
5. Dr. Vijaya. B
6. Dr. ShanthiIyer
7. Dr. S.K. Sarangi

**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
<b>I Semester</b>								
MBT-101	Basic Microbiology	T	4	3	30	70	100	2
MBP-102	Basic Microbiology	P	3	3	15	35	50	1
<b>Total Marks and Credits for I semester</b>							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
<b>II Semester</b>								
MBT-201	Microbial Taxonomy & Culture Techniques	T	4	3	30	70	100	2
MBP-202	Microbial Taxonomy & Culture Techniques	P	3	3	15	35	50	1
<b>Total Marks and Credits for II semester</b>							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
<b>III Semester</b>								
MBT-301	Microbial Physiology & Microbial Genetics	T	4	3	30	70	100	2
MBP-302	Microbial Physiology & Microbial Genetics	P	3	3	15	35	50	1
<b>Total Marks and Credits for III semester</b>							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
<b>IV Semester</b>								
MBT-401	Molecular biology and Recombinant DNA Technology	T	4	3	30	70	100	2
MBP-402	Molecular biology and Recombinant DNA Technology	P	3	3	15	35	50	1
<b>Total Marks and Credits for IV semester</b>							150	3

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
<b>V Semester</b>								
MBT-501	Agricultural & Environ. Microbiology	T	4	3	30	70	100	2
MBT-502	Food & Dairy Microbiology	T	4	3	30	70	100	2
MBP-503	Agricultural & Environ. Microbiology	P	3	3	15	35	50	1
MBP-504	Food & Dairy Microbiology	P	3	3	15	35	50	1
<b>Total Marks and Credits for V semester</b>							300	6

Paper No.	Title of the paper	Type of paper	Hours/Week	Duration of Exam (Hours)	IA	Exam	Total Marks	Credits
<b>VI Semester</b>								
MBT-601	Immunology & Medical Microbiology	T	4	3	30	70	100	2
MBT-602	Industrial Microbiology & Microbial Technology	T	4	3	30	70	100	2
MBP-603	Immunology & Medical Microbiology	P	3	3	15	35	50	1
MBP-604	Industrial Microbiology & Microbial Technology	P	3	3	15	35	50	1
<b>Total Marks and Credits for VI semester</b>							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, BANAGALORE

## Syllabus for B.Sc. MICROBIOLOGY

(Credit Based Semester Scheme)

### SEMSESTER-I

#### MBT 101- BASIC MICROBIOLOGY

Total hours:52.

##### Unit 1. Introduction, History and Scope of Microbiology

1. Microbes and origin of life 10 Hour
2. History and 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, LazaroSpallanzani, 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
  - e) Electron Microscopy- TEM and SEM

##### Unit 3. Analytical techniques

5 Hours

Working principles and applications of – Centrifuge, Ultracentrifuge, Spectrophotometer, Chromatography (Paper and TLC).

##### Unit 4. 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, endosperm, flagella and capsular staining

##### Unit 4. Sterilization Techniques

12 Hours

1. Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, micro biostatic agents and antimicrobial agent.
2. Evaluation antimicrobial chime agents-Tube dilution and agar plate techniques-well method and disk plate method.
3. Physical methods of control-Principle, construction and application of most 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 y 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 5. 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**- Acyclovir (nucleoside)
  - d) **Synthetic** Chemotherapeutic agents- Nalidixic acid
5. Development of Resistance to antibiotics- a brief account.

## SEMESTER I

### MBP 102- BASIC MICROBIOLOGY

Total Units: 15

1. Safety measures in Laboratory. 1 unit
2. Study of compound 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, calculation of NA (Numerical Aperture), RP (Resolving Power) and colony counter, inoculation loop and needle, Incubator, centrifuge, pH meter, Seitz filter, 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 petri-plates 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 unitsStudents have to submit of 3 bacterial slides (permanent) for the examination.

#### Practical Examination Scheme

(35 marks)

#### **Major:**

Staining techniques/Microscopy/Sterilization

(20 marks)

#### **Minor:**

Media formulation/Analytical techniques/Temporary slides/Spotters

(15 marks)

**Record:**To be submitted

#### **REFERENCES:**

1. Aneja K.R. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi.
2. Atlas R.M. *Microbiology- Fundamentals and applications*, Macmillan Publishing Company, New York.

3. Benson Harold J. Microbiological Application, WCB McGraw-Hill of India Private Limited.
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*, WCBMcGraw-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**  
**MBT 201 – MICROBIAL TAXONOMY AND CULTURE TECHNIQUES**

Total hours: 52.

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

1. Study of Viruses

19

Hours

- a) Early developments of virology
  - b) Principles of viral taxonomy
  - c) General structure and properties of viruses
  - d) Virus Purification and assay
  - e) Study of Cyanophages and Mycophages
  - f) Structure, reproduction, cultivation and significance of Bacteriophage (T4 and lambda)  
Plant viruses (TMV)  
Animal viruses (HIV and Herpes Virus)
  - g) Prions and Virioids – Nature and significance
2. Comparison of the three domains of organisms: Bacteria, Archaea, Eucarya (tabular and diagrammatic)
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, nucleoside, flagella, Pili/fimbriae, slime layer, capsule, spores and cysts
  - c) Classification of Bacteria-Brief account of major characteristics used in bacterial classification.
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 Cyano bacteria (type study of Anabaena and Spirulina). Parallelism between bacteria and cyano bacteria
- 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.

18 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.

### **Unit 3 Microbial growth**

15 Hours

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.

## **SEMESTER II**

### **MBP202-MICROBIAL TAXONOMY AND CULTURE TECHNIQUES**

Total units: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 2 units
  - a) Preparation of serial dilutions.
  - 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, Pencillium, Yeast, Rhizopus and Fusarium (Specimens) 2 units
8. Demonstration of slide culture technique of fungi. 2 units
9. Study of protozoa- Amoeba, Paramaecium and Euglena. (Permanent slides)
10. Study of Blue green algae- Anabena and Spirulina. (Specimens) 1 unit

Students have to submit of two fungal and the Blue-green algae slide (permanent) for the examination.

## **Practical Examination Scheme**

(35 marks)

### **Major:**

Cell count/Motility/ Isolation techniques/Morphological characteristics

(20 marks)

### **Minor:**

Media formulation/Media components/Temporary slides/Spotters

(15 marks)

**Record:**To be submitted

### **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 Klein Donald A., 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

### MBT301 – MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

Total hours: 52

#### Unit 1. Microbial Physiology 32 Hours

1. Biomolecules – A brief account of the properties, classification and importance of carbohydrates, lipids and proteins. 3 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. 5 Hours
3. Bioenergetics – Free energy, ATP and its production, other high energy compounds. 3 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. 10 Hours
6. Fermentation – Fermentative modes in microorganisms – alcoholic, Lactic acid – hetero and homo, acetic acid, propionic acid, butyric acid, mixed acid and butanediol fermentation. 6 Hours
7. Bacterial photosynthesis – photosynthetic pigments of prokaryotes, photosynthesis in purple and green bacteria. 4 Hours

#### Unit – 2 Genetics 20 Hours

1. Genomic organisations in prokaryotes and eukaryotes. 2Hours
2. Nucleic acids: Chemical compositions of DNA & RNA, Watson & Crick model of DNA, Types of DNA: A,B,Z and H, Supercoiling of DNA . 3 Hours.
3. DNA replication in Prokaryotes : Semi, Coservative methods, Rolling circle model, origin of replication , , Primers and templates, replication fork, unidirectional and bidirectional (Theta model). 4 Hours.
4. Genetic recombination in bacteria: Conjugation, F+ vs F- , Hfr + vs F-, F<sup>-</sup> vs F-, transformation: griffith's experiment and mechanism, transduction: generalized and specialized. 4 Hours.
5. Mutations- Molecular basis of mutation, spontaneous and induced mutations, detection and isolation of mutants (Replica plate method). 6 Hours.
6. Transposable elements – a brief account 1Hours.

## SEMESTER III

### MBP 302- MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

Total units: 15

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|--|---------|
| 1. Determination of growth curve for fungi by colony diameter method.                          | 2 units |
| 2. Biochemical tests used for the identification of bacteria.                                  | 8 units |
| 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 test   |         |
| g) Oxidase test  |         |
| 3. Estimation of reducing sugar glucose - by DNS 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   | 1 unit  |
| Conjugation- F v/s F <sup>+</sup> , Hfr v/s F <sup>+</sup> , F <sup>'</sup> v/s F <sup>+</sup> |         |
| Transformation- Griffith's experiment and mechanism  |         |
| Transduction- generalized and specialized  |         |

### Practical Examination Scheme

(35 marks)

#### Major:

Estimation of Biomolecules

(20 marks)

#### Minor:

Growth curve/Biochemical tests/Spotters

(15 marks)

**Record:** To be submitted

#### 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 Froster, 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.

## SEMSESTER-IV

### MBT 401– MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

	Total hours: 52.
<b>Unit 1. Molecular Biology</b>	20 Hours
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.	6 Hours
3. Gene Structure and expression.	4 Hours
4. Regulation of gene expression in prokaryotes- The operon concept, Induction and repression, The lac operon. Tryptophan operon, Catabolic repression and Attenuation.	7 Hours
<b>Unit 2. Recombinant DNA technology</b>	32 Hours
1. History and fundamentals of r-DNA technology	1 Hour
2. Tools for r-DNA 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- $\lambda$ and M 13, Cosmids-properties.	6 Hours
4. Vectors for plants: <i>Agrobacterium tumifaciens</i>	2 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.	2 Hour
8. Transformation of r-DNA into target host organisms: Calcium chloride mediated gene transfer, <i>Agrobacterium</i> mediated DNA transfer, Electroporation, Microinjection, Liposome fusion and Micro particle bombardment.	4 Hours
9. Screening and selection of recombinant host cells: Insertional inactivation. <i>In situ</i> colony/DNA hybridization, and immunological techniques.	3Hours
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 b) Agriculture: nif gene cloning	2 Hours
12. Potential hazards and safe guards of genetic engineering	1 Hour

**SEMESTER-IV**  
**MBP 402– MOLECULAR BIOLOGY AND RECOMBINANT**  
**DNA TECHNOLOGY**

Total Units: 15.

- |  |        |
|--|--------|
| 1. Preparation of buffers-citrate and phosphate buffers.                             | 1unit  |
| 2. Estimation of DNA by Diphenylamine method.  | 1unit  |
| 3. Estimation of RNA by Orcinol method.  | 1unit  |
| 4. Determination of MIC of antimicrobial agents.                                     | 2units |
| 5. Evaluation of antimicrobial antibiotic sensitivity tests-paper disc plate method. | 2units |
| 6. Development of antibiotic resistance in bacteria.                                 | 1unit  |
| 7. Isolation of plasmid DNA from bacteria and separation by gel electrophoresis.     | 2units |
| 8. Restriction digestion of DNA.   | 2units |
| 9. In vitro DNA ligation.  | 2units |
| 10. Charts on genetic engineering.   | 1unit  |
| a) pBR 322   |        |
| b) pUC 18 and 19   |        |
| c) SV 40   |        |
| d) Bacteriophages- Lambda  |        |
| e) Gene cloning  |        |
| f) Selection of recombinants by replica plate technique.                             |        |

**Practical Examination Scheme**

(35 marks)

**Major:**

Estimation of DNA,RNA/Isolation of Genomic and Plasmid DNA

(20  
marks)

**Minor:**

Preparation of Buffers/Digestion/Ligation/Vectors/Antibiotic  
resistance/Spotters

(15  
marks)

**Record:** To be submitted

**REFERENCES:**

1. Gerald Karp, Cell Biology, McGraw Hill Book Company, New York.
2. Nelson David L. and Cox Michael M. Lehninger Principles of Biochemistry, Macmillan Press/Worth Publishers, New Delhi.
3. Pelozar 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. Ingrnam 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

### PART A: Agricultural Microbiology

Total hours allotted: 40

#### Unit 1. Microbiology of Soil

1. Soil -definition, types, physical and chemical characters, soil profile; Soil microorganisms -Bacteria, fungi, actinomycetes, algae, protozoa, and viruses. 3 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. **Microbes and biogeochemical Sciences** -Nitrogen and Carbon.
4. **Bioleaching** -Copper and Iron -ore form available, areas of deposits, methods of leaching, mechanism and significance.
5. Biodegradation -Cellulose, Pectin, plastics and pesticides.

#### Unit 2: Agricultural Microbiology

1. **Microorganisms in agriculture:** Biochemistry, genetics and physiology of Nitrogen fixation, Symbiotic Rhizobium, Non-symbiotic- Azitobacter, BGA and associative Azospirillum associations. 5 Hours
2. **Biofertilizers:** Definition, Types (Bacterial, fungal, phosphate solubilizers, BGA, plants- Azolla): kinds of association mode of application and merits. 2 Hours
3. **Biopesticides:** Introduction, types (Bacterial- Bacillus thuringiensis, viral- NPV, fungal- Trichoderma), mode of action, factors influencing genes involved and target pests. 2 Hours
4. **Study of microbes as plant pathogens-**  
Fungal: Puccinia, Plasmodiopsis, Cercospora, Bacterial: Xanthomonas oryzae, Mycoplasma- Sandal spike, Viruses- Tomato leaf curl. 5 Hours

### PART B: Environmental Microbiology

#### Unit 3. Microbiology of air

1. Introduction -definition, atmospheric layers, sources of microorganisms, microflora of indoor and outdoor air, factors affecting air microflora. 5 Hours
2. **Techniques of trapping air borne microorganisms and Advantages and disadvantages** -Gravity slide, petriplate exposure, vertical cylinder, Hirst spore trap, Rotorod sampler, Andersen sampler, impingers: Lemon's devices and filtration. 5 Hours
3. Biohazards in occupational environment, allergy testing. 2 Hours
4. Significance, control and Management of Airborne Microbes. 1 Hour

#### Unit 4. 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
2. Determination of the sanitary quality of water- MPN index, coliform test, Membrane filtration.
3. 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 <i>Rhizobium</i> from legume root nodules (Gram staining)  | 1 unit  |
| 3. Isolation of actinomycetes from soils using Glucose Aspergine Agar by plate method.   | 2 units |
| 4. Study of antagonism between soil microorganisms by plate methods- Bacterium Vs Bacterium, Bacteria vs. Fungus, Fungus vs. Fungus,   | 3 units |
| 5. Study of plant pathogens- Tikka Disease, Sandal Spike, Downy Mildew and 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 <sub>2</sub> S strip test, MPN methods -for potable and sewage water:   | 2 units |
| 10. Study of fungi - <i>Cladosporium</i> , <i>Helminthosporium(bipolaris)</i> , <i>Mucor</i> , <i>Curvularia</i> , <i>Alternaria</i> , <i>Geotrichum</i> , <i>Trichoderma</i> . (specimens ) | 2 units |

**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**

**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 Biopreservation. 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- fungal lipids. 4 hours

**Unit 2. Dairy Microbiology**

**1. 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

**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, Methylene blue test 4 Hours

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

Prebiotics and Probiotics 5 Hours

**SEMESTER V**  
**MBP504 –Food and Dairy Microbiology practical**

Total units allotted: 15

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

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: 40

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. 3 Hours
5. **Antigen and Antibody reactions** –Agglutination(blood grouping), Precipitation,  
Complement fixation test, Immunoelectrophoresis, labelled antibodies -RIA, ELISA,  
immunofluorescent 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 BQG.  
Killed vaccines-pertussis  
Toxoid -tetanus.  
Recombinant 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
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. Syphilis
  - b. Diphtheria
  - c. Tetanus
  - d. Typhoid
  - e. Cholera
  - f. Tuberculosis**Viral Diseases**
  - a. Rabies
  - b. Hepatitis A,B
  - c. HIV**Protozoan Diseases**
  - a. Amoebiasis
  - b. Malaria**Fungal Diseases**
  - a. Candidiasis
  - b. Cutaneous mycoses

17 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, MacConkey Agar and 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) 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 Immuno Diffusion   | 1 unit  |
| 11. Study of AFB –slide  | 1 unit  |
| 12. Study of pathogenic microorganisms – <i>Shigella spp</i> , <i>Clostridium spp</i> , <i>Staphylococcus spp</i> ; <i>Streptococcus spp</i> , <i>Entamoeba spp</i> ; <i>Plasmodium spp</i> , and <i>Candida spp</i> ( 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 Osbome 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: 40

- |   |          |
|---|----------|
| 1. History, scope and development of industrial microbiology.   | 1 Hour   |
| 2. Isolation and screening of industrially important microorganisms.  | 1 Hour   |
| 3. Strain improvement methods.  | 1 Hour   |
| 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. | 3 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

1. Immobilization of enzymes and cells: 2 hours
2. Production of chemicals -Fermentative production of
3. Alcohol : industrial alcohol and alcoholic beverages - beer, wine, and whiskey.
4. Organic acids -citric acid
5. Vitamins-B12
6. Amino acid -glutamic acid
7. Antibiotics -penicillin
8. Enzymes –amylase 10 hours
9. Biofuels: Methane and hydrogen gas production, types of substrate, process, mechanism by products, 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 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. Estimation of Lactic acid in milk 2 units
7. Biogas production 1 unit
8. Mushroom Cultivation. 1 unit
9. Charts on the different types of fermentors
- a) Typical stirred aerated fermentor b) Tower fermentor c) Air lift fermentor .d) Bubble cap fermentor.
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 Higton, Industrial Microbiology - An introduction, Blackwell Science. Delhi.
5. McNeil. B, and Harvey L.M., Fermentation- A Practicat Approach, IRL Press, New York.